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SHOCKS FROM SECONDARY ALTERNATING CIRCUITS.

In commenting several weeks ago on a letter from a Demerara correspondent describing a fatal accident from electric shock, we remarked that it could not have been due to the primary voltage as asserted, this opinion being based upon the assumption that the only leakage in the system, as stated, was that from points of defective insulation found in the transformer. In this issue several correspondents point out that shocks from the primary voltage of an alternating system through contact with the secondary circuit are not unusual, and are due to the fact that in addition to a contact between the primary and secondary in the transformer there is also present a ground connection with the primary at some point or points of the system. It is very reasonably shown that in an alternating system numerous opportunities for leaks to ground from the primary are provided by the many transformers and their connections and by contacts with trees and otherwise. As a consequence, if the insulation between the primary and secondary is defective, or both are grounded on the iron of the transformer, a circuit containing the primary voltage may be completed by contact with the secondary, and without the latter being affected or the fuses blown if the resistance interposed in the ground connection is that of the human body. Several methods have been proposed to obviate this danger. One consists in so winding the transformer coils as to reduce the amount of primary voltage that may be introduced into the secondary circuit through a contact between the coils. Another method provides for grounding of the secondary momentarily at short intervals of time by means of clockwork. Still another consists in grounding the iron of the transformer, though this does not provide for a direct contact between the primary and secondary when both are free of grounds on the transformer. In one instance of which we know, the superintendent of a large alternating plant grounded the secondary in his house through a relay of considerable resistance, so arranged as to break the house circuit in case of the secondary being subjected to the primary voltage.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The catalogue of members in the January number of the *Transactions* of the American Institute of Electrical Engineers shows a most gratifying growth of the membership, which numbered 913 on February 1, an addition of 79 names since September 1 of last year. Referring to previous catalogues, we find that the membership has more than doubled since May 1, 1890, at which time it was 427. On January 1, 1892, the membership had increased to 583, on June 1, 1893, to 690, and on September 1, 1894, to 834. The average monthly increase in the periods above given has been 7.8, 6.3, 7.2, and 16, respectively, so that the last five months, by this comparison, show the largest rate of increase. Since June 1, 1893, the increase in the entire membersip has been 32 per cent., while that of Chicago is 70 per cent., and of Philadelphia and San Francisco, 157 per cent. each; the membership of Boston remains the same, that of Brooklyn has increased 50 per cent., and of New York only 22 per cent., or at less than the average rate. While the great increase in Philadelphia is to be ascribed to the influence of the annual meeting held there last spring and the election of Prof. Houston to the presidency, that of Chicago is undoubtedly due to the institution of its local meeting, and of San Francisco to the effort made to obtain a sufficient membership to follow in Chicago's footsteps. At present Washington, Baltimore, Schenectady, Philadelphia and Pittsburgh also have a sufficient membership to hold local meetings, and as the value of the *Transactions* and the vigor of the Institute would be notably increased if these places were to take advantage of the opportunity thus afforded, it is to be hoped that, at least in the three latter places,

the members will soon take the matter under consideration. Were this done and the meetings instituted, we feel that the increased interest in the Institute and its work would not be confined to these localities alone, and that the result would be to very soon carry the membership beyond the one thousand mark.

THE LATEST SENSATION.

Quite a little excitement seems to have been caused by the recently published statements regarding the possible introduction of a very serious rival to the electric light. We refer to the recent accidental discovery that coal dust and lime can be chemically combined, forming a substance resembling coal and called "calcic carbide" which possesses the very peculiar property that if placed in water it changes into slacked lime or "whitewash" and acetylene gas, the richest illuminating gas known, having an illuminating power of 15 times that of ordinary gas. If this gas can thus be produced so that in illuminating power it will be equal to ordinary gas at 30 cents per thousand, as is claimed in a recent estimate, it certainly will become a very serious rival, but fortunately these figures are mere estimates, and until they are substantiated they need not worry the managers of central stations, or those who install and manufacture electric lighting apparatus. The published statements, all of which have been abstracted at some length in our Digest, come from enthusiasts and may therefore be taken with a few grains of salt. For example, in one of the estimates the cost of an electrical horse-power per hour is assumed at the absurd figure of .28 cent It is satisfying to the electrical engineer to know that this curious compound can be produced only in the electric arc, and that if its production on a large scale is undertaken there will be a large demand for electrical machinery. While it has yet by no means been demonstrated that the gas thus produced will be a serious rival to the electric light, yet it will be well to watch the developments. Should it turn out that central stations are affected by it, then why not take the bull by the horns and erect, in connection with each central station, a few good sized electric furnaces for producing this material; this will form an excellent and flexible substitute for the much desired day load, enabling the engines to be used to their full power during the whole twenty-four hours. Although the machinery in continuous-current stations is not as well adapted for an electric furnace as it might be, yet it does not seem that there would be any insurmountable difficulties. Until the manufacture of this material has been undertaken on a large scale, however, it is too early and quite needless to make any estimates of whether it would pay central stations to go into the business of making it.

ELECTROCUTION.

The unwarranted assertion made some months ago by D'Arsonval to the effect that execution by electricity as practiced in New York State does not produce true death, reopened a discussion far from agreeable to the electrical public, and offered an opportunity for sensationalism of which due advantage was taken by the newspaper press in general and by one P. J. Gibbons in particular—the latter, we regret to note, being encouraged by several of our electrical contemporaries, who apparently did not recognize the absurdity of his claims. In order to definitely settle this distressing subject the New York State authorities very wisely concluded to request the attendance at an execution of a committee whose conclusions in the matter would be accepted as authoritative, not only in this country, but abroad among those influenced by D'Arsonval's authority. To this end Dr. Augustin H. Goelet, the eminent therapeutist, and Mr. A. E. Kennelly were invited to witness, on January 28, the execution of a negro murderer at Sing Sing, and in this issue we publish the result of the observations made by these gentlemen and the general conclusions founded upon them. It will be seen that the verdict is open to no misconstruction, and emphatically pronounces that death in the case witnessed was instantaneous and painless, with absolutely no possibility of resuscitation. There should have been no question of this, and it is difficult to see how one with the standing in the scientific world of D'Arsonval could have been led into the gross error of asserting otherwise. That over 18 horse-power of energy, racking and rending such a delicate organism as the human frame for almost a minute and disintegrating its fluids, could do otherwise than produce a fatal effect is beyond belief. How destructive is the effect of this energy was shown by the post-mortem examination, when it was found that the blood circulatory system was destroyed, numerous blood vessels of the brain ruptured and the blood itself changed so as to be no longer capable of supporting life. As the method of electrocution practiced at Sing Sing is the same as in other prisons in New York State, the general conclusion as to its absolute efficiency may be accepted as final in all cases, and should definitely put to rest a harrowing subject. It will be noted that the report disclaims any inference that may be drawn from it as to the fatal effect of ordinary electric shocks. Through the short duration or high resistance of a contact under these circumstances, the energy expended may be very small, and the effect merely to suspend animation, which may be again restored through the application of the necessary treatment, a knowledge of which should be acquired by all electricians.

First Annual Convention of the Indiana Electric Light and Power Association.

The first convention of the Indiana Electric Light Companies, which met on Jan. 30, 1895, in the club room of the Hotel English, Indianapolis, was a success in every respect, and reflected much credit on the gentlemen in charge of its organization and conduct.

The meeting was called to order at 2 p. m., by Chairman H. W. Frund, who, in an opening address, said that the object of the Indiana Electric Light Association was not to further the interests of its members in a mercenary sense, but to secure the mutual benefit resulting from an interchange of ideas born of practical experience, to the end that they may not alone cheapen the production of electric light, heat and power, and protect themselves from imposition from whatever source, but also to render better service in all branches of their business, thus benefiting their patrons while furthering their own interests in a legitimate business way.

J. D. Edwards was chosen secretary *pro tem.* A committee of ten on organization reported a constitution and rules similar to those of the National Electric Light Association, excluding, however, supply men and manufacturers of apparatus and confining active membership in the association to those who are owners of electric light and power plants or representative managers. After the report of the committee and adoption of a constitution, the supply men and others not interested in lighting companies left the room, and at an election of officers then held, the following named gentlemen were unanimously elected without ballot:

President, J. W. Roney, Richmond; vice-president, W. K. Smith, Union City; secretary, James Boyce, Muncie; executive committee, H. W. Frund, Vincennes; H. A. Smock, Martinsville; C. C. Perry, Indianapolis; J. W. Morrison, Frankfort, and J. D. Edwards, Decatur.

The night session was called to order by President Roney, at which various committees were appointed and a discussion held in reference to lighting interests. The secretary was directed to forward blank applications to all Indiana electric lighting companies not represented, and the membership fee was fixed at $5.00 per annum. The next meeting will be held in August, in Indianapolis, if called by the president and executive committee. The annual meetings are thereafter to be held on the first Wednesday in February of each year. The following gentlemen were in attendance at the meetings: E. W. Boden, C. H. Kerlin, Cambridge City; J. W. Cole, Greencastle; L. Wohlgemuth, Rochester; L. F. Putnam, Attica; T. W. McNamee, Wabash; O. C. Irwin, Greenfield; Z. F. Graham, Washington; W. K. Smith, Union City; Jas. A. Halstead, Jos. S. C. Sarver and E. W. Smith, Brazil; H. A. Smock, Martinsville; O. L. Moorman, Winchester; J. D. Edwards, Decatur; Victor E. Seiter, Logansport; J. W. Morrison, Frankfort; J. W. Roney, Richmond; James Boyce, Muncie; C. E. Latta, Goshen; W. Wilkemeyer, Evansville; J. W. Draper, Ligonier; H. A. Root, Michigan City; C. C. Perry, Indianapolis; H. W. Frund, Vincennes.

Cold Light.

In a recent Royal Institution lecture a piece of photographic paper moistened with liquid air was held within a few feet of an arc lamp and it was found that it was not acted upon by the light.

The National Electric Light Association.

The next annual meeting of the National Electric Light Association, to take place at Cleveland next week, bids fair to be exceedingly interesting, both in the scope and the character of the work laid out, as will be seen from the complete programme of the convention given below.

A meeting of the Executive Committee will be held in Parlor 138, Hollenden Hotel, at 9 a. m. on Tuesday, Feb. 19, and the morning session will commence at 10:30 o'clock in Army and Navy Hall. Following an address of welcome by the Mayor of Cleveland, President M. J. Francisco will open the convention with the usual presidential address, and the following programme will then be taken up:

Paper, by N. W. Perry, "The Storage of Energy Essential to Central Station Economy: How It May Be Accomplished, and the Economies Resulting." Discussion by John W. Langley, W. M. Stine and M. J. Perry.

Report of Committee on Relations between Manufacturing and Central Station Companies; Frederic Nicholls, chairman.

Afternoon Session, 2 o'clock.

Paper, by E. J. Houston and A. E. Kennelly, on "A New Method of Measuring Illumination." Discussion by W. A. Anthony, C. D. Haskins, W. S. Howell, Edward Weston and L. Stieringer.

Report of Committee on Data; H. M. Swetland, chairman. Discussion by W. R. Gardener, E. L. Powers and H. W. Sexton.

Paper, by Walter E. Harrington, on "Correct Method of Protecting Electric Circuits."

Questions and Answers. What Is It You Wish to Know?

WEDNESDAY, FEB. 20.

Morning Session, 10 o'clock.

Paper, by Edward Weston, on "Some Economies in Electric Light and Power Stations."

Paper, by C. N. Black, on "Large Arc Dynamos." Discussion by S. M. Hamill, J. J. Wood, F. W. Rollins and E. R. Weeks.

Topic, "How to Light Large Cities." Discussion by Frederic Nicholls, Geo. A. Redman, Jas. I. Ayer, E. F. Peck, C. R. Huntley, Robert Lindsay, F. H. Clark, T. C. Smith and J. F. Morrison.

Report of Committee on Finance; John A. Seely, chairman.

Questions and Answers. What Is It You Wish to Know?

Afternoon Session, 2.30 o'clock.

Paper, by E. A. Leslie, on "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint." Discussion by H. J. Smith, W. H. Browne, C. H. Wilmerding, John A. Seely and C. L. Edgar.

Paper, by L. B. Marks, on "Arc Carbons and the Rating of Arc Lamps."

Topic, "Incandescent Lighting vs. Other Methods." Discussion by H. T. Edgar, E. F. Phillips, W. S. Barstow, E. A. Armstrong, J. Gwynn and B. P. Holmes.

Questions and Answers. What Is It You Wish to Know?

Evening Session, 8 o'clock.

Topic, by A. J. Wurtz, "Practical Demonstrations of Protecting Lines from Lightning."

THURSDAY, FEB. 21.

Morning Session, 10 o'clock.

Paper, by Dr. Louis Bell, on "The Monocyclic System." Discussion by A. E. Kennelly, L. B. Stillwell and J. F. Kelly.

Report of Commitee on Rules for Safe Wiring; Wm. J. Hammer, chairman.

Topic, "Underwriters' Rules vs. National Electric Light Association Rules." Discussion by Wm. Brophy, C. H. J. Woodbury, J. J. Burleigh and A. W. Field.

Afternoon Session, 2.30 o'clock.

Election of officers.

Special rate railroad tickets will be good from three days before the convention until three days after.

The following is a list of those who have engaged seats on the Electrical Special, leaving New York on Monday, the 18th inst., at 9:30 a. m., via New York Central road:

Jas. P. McQuaide,	E. F. Peck,	W. J. Johnston,
C. O. Baker, Jr.,	Mrs. E. F. Peck,	Mrs. W. J. Johnston,
Mrs. C. O. Baker, Jr.,	A. J. Purinton,	R. O. Heinrich,
A. J. Belden,	Cecil P. Poole,	E. W. Little,
Mrs. A. J. Belden,	Chas. D. Shain,	T. C. Martin,
H. J. Smith,	E. H. Johnson,	F. A. Scheffler,
Mrs. H. J. Smith,	A. J. Martin,	Mrs. F. A. Scheffler,
M. J. Francisco,	Jos. Sachs,	John A. Seely,
Mrs. M. J. Francisco,	P. L. McLaren,	S. L. Coles,
I. H. Francisco,	F. W. Harrington,	Edward Weston,
Don Francisco,	F. S. De Ronde,	A. E. Bakewell,
C. H. McIntire,	Mrs. F. S. De Ronde,	Geo. M. Phelps,
Mrs. C. H. McIntire,		

The Western contingent of the convention delegates will go by special car on the Lake Shore Railroad, leaving Chicago at 8:30 p. m. Monday, Feb. 18. The railroad officials have made particular arrangements for the comfort and convenience of the party, and the prospect is good for a pleasant time en route.

On Magnetic Potential.*

BY FREDERICK BEDELL.

Introduction.

In 1882 Prof. Clausius discussed at length the dimensional formulæ of the electrostatic and electromagnetic systems and derived the dimensions for magnetic pole (m) from a consideration of the equivalence of a magnetic shell and a circuit carrying a current of electricity, as first pointed out by Ampere; thus,

$$\text{Area} \times \text{current} = \text{magnetic moment} = ml. \qquad (1)$$

In the electromagnetic system this gives a magnetic pole the dimensions $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1}$, which accords with Maxwell and subsequent writers. In the electrostatic system, however, this gives to magnetic pole the dimensions $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2}$, for which Maxwell gives $M^{\frac{1}{2}} L^{\frac{1}{2}}$. The reasoning of Clausius was apparently correct, and he concluded Maxwell was in error. This conclusion was indorsed by Prof. Everett. The discussion which followed, "On the Dimensions of a Magnetic Pole in the Electrostatic System of Units," needs merely a mention here.

Prof. J. J. Thomson pointed out that the equivalence of a circuit and a magnetic shell, as given by Ampere, is correct only in a medium with permeability equal to unity. The factor μ, denoting the permeability of the medium, should be introduced into the general statement, and (1) should be written—

$$\mu \times \text{current} \times \text{area} = \text{magnetic moment}. \qquad (2)$$

In the electrostatic system μ has the dimensions $M^0 L^{-2} T^2$; hence m has the dimensions $M^{\frac{1}{2}} L^{\frac{1}{2}}$, as given by Maxwell. In the electromagnetic system permeability is a number without dimensions, and the presence of μ as a factor in (2) does not affect the dimensions of m. Prof. Thomson derived these same dimensions from the expression for the work done in carrying a pole around a circuit. He also pointed out that the factor μ should enter into the expression for the attraction between magnetic poles; thus,

$$f = \frac{mm'}{\mu r^2}. \qquad (3)$$

Prof. Clausius, however, still considered that he was correct, maintaining that, if a circuit and magnetic shell are equivalent, they must be mutually replaceable, and that a change in the medium would affect one as the other. Prof. Everett subsequently concluded that Maxwell was correct, obtaining the dimensions of Maxwell from the galvanometer law and the law of Faraday, although he did not see wherein Clausius was wrong in obtaining his results from the equivalence of a circuit and a magnetic shell. Helmholtz, too, showed lack of confidence in the equivalence of the magnetic shell, and stated that the Ampere-Weber hypothesis must be looked upon as neither verified nor even completely worked out. He gave no consideration to the nature of the medium, which, as Prof. Thomson pointed out, has a most important bearing on the question. It was left for Dr. Lodge to point out that a distinction should be made between the permeabilities of the medium of the space corresponding to the space of the equivalent shell and of the exterior medium. It was he who pointed out that the magnetic moment of a circuit is equal to the product of the current, the effective area, and the permeability of the *interior* space; the magnetic moment is entirely independent of the permeability of the surrounding space. The failure to recognize this fact was the cause of the erroneous views which had been set forth by such distinguished scientists.

It is the purpose of this paper to consider the effect of permeability upon the magnetic potential due to a magnet or a current of electricity, and to show more definitely the bearing of some of the above relations.

The expressions for the magnetic potential at a point, as ordinarily given, are

$$\text{magnetic potential due to a magnet} = V = \Sigma \frac{m}{r}; \qquad (4)$$

$$\text{magnetic potential due to a current} = V = I\Omega. \qquad (5)$$

In (5) I denotes the current, and Ω denotes the solid angle subtended by the circuit at the point, the potential of which is under consideration.

* From the *Physical Review*.

In the electromagnetic system these equations lead to the following dimensions for magnetic potentials:

$$V = \frac{m}{r} = \frac{M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1}}{L} = M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1}; \quad (6) \text{ [from (4)]}$$

$$V = I\Omega = M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1}; \quad (7) \text{ [from (5)]}$$

These equations (6 and 7) agree with each other and with the dimensions for magnetic potential in the electromagnetic system as usually given, and will be found correct.

In the electrostatic system, equations (4) and (5) give the dimensions:

$$V = \frac{m}{r} = \frac{M^{\frac{1}{2}} L^{\frac{3}{2}}}{L} = M^{\frac{1}{2}} L^{-\frac{1}{2}}; \quad (8) \text{ [from (4)]}$$

$$V = I\Omega = M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2}; \quad (9) \text{ [from (5)]}$$

These equations (8) and (9) are not concordant, although derived from (4) and (5), which gave correct results in the electromagnetic system. Equation (9) will be found to be correct; equations (8) and (4) are not.

If we denote the permeability of the space *exterior* to the magnet by μ_ε

$$V = \Sigma \frac{m}{\mu_\varepsilon r} \quad (10)$$

which accords with (3), and is true in any system of units.

In the electromagnetic system the dimensions of μ are $M^0 L^0 T^0$; hence μ does not affect the dimensions in this system, and (6) and (7) are correct.

In the electrostatic system the dimensions of $\mu L^{-2} T^{-2}$. Hence the dimensions of magnetic potential derived from (10) are:

$$V = \frac{m}{\mu_\varepsilon r} = \frac{M^{\frac{1}{2}} L^{\frac{1}{2}}}{L^{-2} T^0 L} = M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2}, \quad (11)$$

which agrees with (9), and is correct.

In a Uniform Medium the Magnetic Potential Due to a Current is Independent of Permeability.

The introduction of μ in the expression for the magnetic potential due to a magnet (4) gives the same dimensions to magnetic potential (see 11) as derived from (5), the expression for the magnetic potential due to a current. That the permeability of the medium should be taken into consideration, as above, in the expression for the magnetic potential due a magnet is clear; but should we not expect the permeability to enter into a similar manner in the corresponding expression for the magnetic potential due to a current (see 5)? The equivalence of a current and a magnetic shell as stated by Ampere would lead to this conclusion. Such, however, is not the case; equation (5) holds true as it is written. The magnetic potential at a point due to a current is independent of the permeability—a fact the explanation of which merits attention.

In *air* the magnetic potential at a point due to a current may be obtained from the principle of the magnetic shell as follows. Consider the circuit replaced by a shell consisting of elementary magnets, with axes in the direction of the thickness of shell. If r and r' are distances of the point P from the two poles of one of these elementary magnets, of length l and pole strength dm, the magnetic potential at the point P, due to this magnet, is

$$dV = \frac{dm}{r} - \frac{dm}{r'}. \quad (12)$$

Inasmuch as the length of the magnet is small compared with its distance from the point P, for r' we may write $r + l\cos a$, where a is the angle between the axis of the magnet and a line connecting it with the point P. Hence

$$dV = dm\left(\frac{1}{r} - \frac{1}{r + l\cos a}\right) = \frac{ldm\cos a}{r^2}, \quad (13)$$

the last term being obtained by approximation. But from the equivalence of a magnetic shell in air (see 1) we have

$$ldm = IdA; \quad (14)$$

where dA represents the polar area of an elementary magnet. Making this substitution in (13), and remembering that

$$\frac{dA\cos a}{r^2} = d\Omega,$$

the solid angle at P subtended by the polar surface of the elementary magnet, we have

$$dV = Id\Omega; \text{ and } V = I\Omega \quad (15)$$

This reasoning holds true for air; but (12), (13), (14) are true only for air, or a medium whose permeability is unity.

For *media other than air* equation (15) still holds. If μ_ε is the permeability of the space *exterior* to the space occupied by the magnetic shell to which the current is considered equivalent, instead of (12) and (13), we have [see equation (10)]:

$$dV = \frac{dm}{\mu_\varepsilon r} - \frac{dm}{\mu_\varepsilon r'} = \frac{1}{\mu_\varepsilon}\frac{ldm\cos a}{r^2} \quad (16)$$

If μ_i is the permeability of the *interior* space, or that occupied by the equivalent magnetic shell, instead of (14), we have

$$ldm = \mu_i IdA. \quad (17)$$

Substituting (17) in (16), we have

$$dV = \frac{\mu_i}{\mu_\varepsilon}\frac{IdA\cos a}{r^2} = \frac{\mu_i}{\mu_\varepsilon} Id\Omega \quad (18)$$

$$V = \frac{\mu_i}{\mu_\varepsilon} I\Omega \quad (19)$$

This is the expression for the magnetic potential at a point P, due to a current I, in a circuit subtending the angle Ω at the point P, when μ_i is the permeability of the space occupied by an hypothetical equivalent shell, and μ_ε is the permeability of the surrounding medium.

In all cases usually considered $\mu_i = \mu_\varepsilon$; that is, in any uniform medium, the magnetic potential due to a current is

$$V = I\Omega \quad (20)$$

and is independent of the permeability of the medium.

On a Proposed Modification of the Generally Accepted Temperature Co-efficient of Resistance for Copper Wires.

BY A. E. KENNELLY AND REGINALD A. FESSENDEN.

In a paper entitled "Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper," read at the International Electrical Congress in Chicago, 1893, and also published in the *Physical Review*, Vol. I., No. 4, page 260, the authors showed that the temperature co-efficient of resistance at any temperature (t° centigrade) between 20° and 250 C., of a sample of good commercial copper wire, which appeared by chemical analysis to have a high degree of purity, could be very closely represented by the formula,

$$\rho_t = \rho_o\ (1 + 0.004065\ t) \quad (1)$$

Recent determinations by Messrs. Dewar and Fleming and Messrs. Swan and Rhodin * concur in giving a linear relation between the temperature and resistance of copper.

As the results of measurements made to determine the temperature co-efficient in annealed copper wire, we have for the range from 0° C. to 100° C. assuming a linear relation, as follows:

Benoit	.373
Calilletet and Bouty	.425
Matthiessen	.422
Siemens	.388
Dewar and Fleming	.424
Kennelly and Fessenden	.406
Swan and Rhodin	.415
We obtain as the mean	.4076

We therefore suggest that since the exact temperature co-efficient is not yet determined, and since it may possibly vary in different samples of copper in commercial use, that the simple formula,

$$\rho = \rho_o(1 + 0.004\ t) \quad (2)$$

may be accepted provisionally for all practical purposes, or, in other words, that the resistivity of copper be considered to increase by 0.4 per cent. per degree centigrade of temperature elevation reckoned from the resistivity at zero centigrade.

Should the corrected co-efficient be subsequently determined to be 0.0041, formula (2) would become,

$$\rho_t = \rho_6\ [1 + 0.004\ (t - 6)] \quad (3),$$

ρ_6 being the resistivity at 6° C.

Similarly, if the co-efficient ultimately accepted should be 0.0042, the corresponding formula would be,

$$\rho_t = \rho_{12}\ [1 + 0.004\ (t - 12)] \quad (4),$$

ρ_{12} being the resistivity at 12° C. and for an accepted co-efficient of 0.0043

$$\rho_t = \rho_{17.5}\ [1 + 0.004\ (t - 17.5)] \quad (5)$$

Consequently, if we adopt equation (2) at the present time, we obtain, pending more exhaustive inquiry, a formula much simpler, more convenient, and probably more nearly accurate than that of Matthiessen, while any future correction can only have, it would seem, an influence upon the standard or datum temperature and a comparatively trivial quantitative effect within ordinary temperature ranges.

* P. R. S., June, 1894.

Does Execution by Electricity, as Practiced in New York State, Produce Instantaneous, Painless and Absolute Death?—Observations Made at the Execution of David Hampton, at Sing Sing, Jan. 28, 1895.

BY A. E. KENNELLY AND AUGUSTIN H. GOELET, M. D.

Some observations by D'Arsonval, of Paris, having led him to the unwarranted conclusion that in electrical executions as practiced in New York State the death of the criminal was not produced by the passage of the current, but by the knife of the surgeon during the subsequent autopsy, considerable discussion has lately arisen as to the correctness of D'Arsonval's opinion.

On the 28th of last November, THE ELECTRICAL WORLD, in the desire to definitely settle this question, directed a letter to Governor Flower, of New York State, requesting that at the next electrical execution scientific witnesses should be selected whose duty should be to make such observations as would throw light upon the matter. This recommendation was favorably received and the writers were appointed to perform this very unpleasant duty on the occasion of the twenty-fourth electrical execution in New York State.

The following observations were made:

An alternating current was used in the execution, which was supplied from an alternator having a frequency of approximately 102.3 cycles, or 204.6 alternations or reversals per second, with an armature specially wound for a maximum E. M. F. of 2,500 volts effective. The field excitation of this alternator was controlled by means of a rheostat inserted in the exciter circuit and situated in the execution chamber.

The electrodes consisted of flexible brass gauze sheets firmly attached to sponges which were saturated with an aqueous solution of common salt. The upper electrode was fitted into a cap, shaped to conform with the top of the criminal's head, and provided with a chin-strap which held it firmly in position. The lower electrode consisted of a similar flexible brass gauze plate about 8″ x 3″ and its moistened sponge, attached by a strap to the calf of the right leg. The criminal was placed in a sitting position in a stout chair to which he was confined by straps. The criminal was a negro, short, but young and of robust physique.

Preparatory to the execution, in order to test the circuit, a bank of 20 incandescent lamps in series was placed in circuit in the chair, when a pressure of 1,740 volts effective was observed on both Weston and Cardew voltmeters, and this pressure was then maintained.

The following are the detailed observations made:

11.18.45 Criminal entered room.
11.18.50 Seated in chair. Straps applied.
11.19.58 Electrodes adjusted and connections made with same.
11.20.13 Current applied at pressure of 1,740 volts. Ammeter nearly dead beat, indicating approximately 8 amperes steady through body of criminal.
11.20.17 Pressure intentionally slowly reduced, and current falling slowly to 1.8 amperes.
11.20.42 Pressure intentionally increased to a maximum not observed, the current increasing to 4 amperes.
11.20.50 Pressure again reduced to about 150 volts, the current falling to 1.3 amperes.
11.21.10 Circuit broken, current off. Period of application 57 seconds in all.
11.21.20 Chest was examined and no action of the heart could be detected. At this time a marked hyperæmia or redness of the skin covering the chest, especially the upper part, was observed. This paled on pressure, the color returning slowly. There was marked pallor of the face, slight froth in the mouth, and pupils of the eyes were dilated.
11.25.00 The criminal was officially pronounced dead.

The moment the current was turned on, the whole body was thrown into a condition of intense tetanic rigidity, the hands were contracted or closed tightly, and the extremities straightened as much as the straps would permit. While the current was on, there was some frothing at the mouth, but there was no audible sound, and no evidence of sensation or suffering. Death was evidently instantaneous and painless.

At 11.33 a. m. the body was placed on the table for examination. At this time the rectal temperature was 100.8 degrees F., and the sphincter was relaxed. The superficial veins of the extremities, especially those of the arms, were empty and collapsed. Incision of the scalp and through the skin of the chest-wall showed that all, or nearly all, of the blood in the body had been driven into the head and upper part of the chest and neck, and that rupture of the over distended vessels had allowed extravasation of blood to take place into the cellular tissues of the scalp and under the skin covering the upper part of the chest, especially near the neck. Here the extravasated blood appeared to be congealed. In marked contrast with the condition of affairs in this location, incision through the abdominal wall showed the tissues to be almost bloodless. Incision into the tissues under the location of the leg electrode showed the same bloodless condition. On removal of the skull-cap, and puncture of the *dura mater* (membrane lining the interior of the skull and enclosing the brain) a great quantity of dark blood escaped, showing that there had been an extravasation into the cranial cavity. This was found to be due to the rupture of the blood vessels. This blood coagulated, but not firmly. A specimen preserved remained fluid and unchanged for days, except that the color became brighter. It was estimated that at least two quarts escaped from the scalp and cranium in removing the brain. On removing the *dura mater* the vessels on the surface of the brain were seen to be distended and there was evidence of rupture in many places. The same condition prevailed throughout its interior, and congealed blood was found at the base of the brain, a condition incompatible with either consciousness or life.

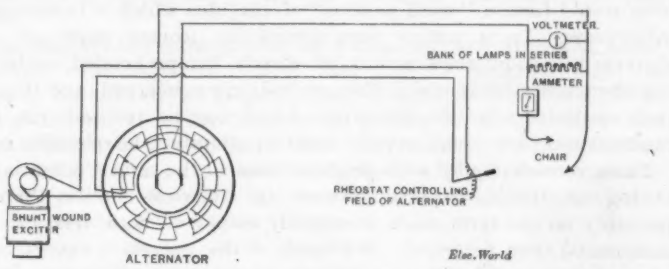


DIAGRAM OF ELECTRICAL CONNECTIONS, OMITTING SWITCHES.

On opening the chest cavity the lungs appeared normal, but extravasation of blood had taken place into the lung tissues at the upper part.

The heart-walls were thin and flabby; the blood retained in the cavity was dark.

On opening the abdominal cavity, the vessels of the intestines, especially those of the small intestines, were distended with blood. The liver was normal but engorged with blood. The kidneys and spleen were normal. The abdominal aorta was empty.

From observations made at the time of the application of the current, which were abundantly substantiated by the result of the autopsy, we conclude that death was instantaneous and painless.

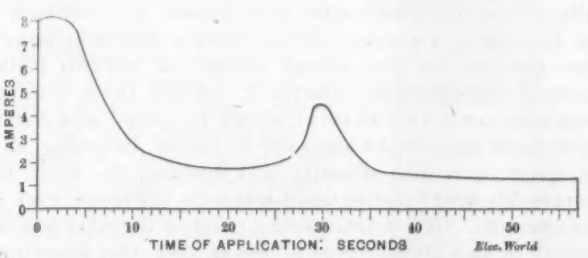


DIAGRAM OF CURRENT STRENGTH APPLIED.

The evidence is, therefore, that a current of 8 amperes, applied through the body at a pressure of 1,740 volts, and representing a power of (1,740 × 8 =) 13,920 watts, or about 18⅔ electrical horsepower, will produce instantaneous, painless, and absolute death; and that the evidence presented by an examination of the brain alone was sufficient to demonstrate the absolute impossibility of resuscitation.

Although in our opinion there is no hope of resuscitation in cases where, as in this electrical execution, an alternating current of sufficient E. M. F. is deliberately sent through the body of the criminal, yet in all cases of accidental contact with high pressure circuits, in our opinion, efforts for resuscitation should be made, since in most cases of accidents from electricity, either from the imperfection of the contact, or its short duration, the current strength passing through the body and the electrical energy expended thereby, might only be sufficient to produce a loss of consciousness.

On Potential.

BY WILBUR M. STINE.

Many scientific terms are employed by people in general with but a vague conception of their real physical meaning. By frequent repetition the term itself becomes so familiar that the mind ceases to concern itself with its definition, and its use becomes one of association merely, without the ability to employ the word in its individual sense. Again, the use of the term in a special, but constantly recurring sense, may be clearly understood as expressing a mere relation; but this leads to a narrow conception of the term and renders its full understanding the more difficult.

Because a term has become familiar through repetition by no means is evidence that it is comprehended. The extent to which our language is built up from the Latin and other tongues has doubtless led to much superficiality in the use of words. If our language was constructed only from native elements each complex term would form a "word-picture" of the idea which it is designed to express. To a native born Greek or Roman many of our abstruse scientific terms would be clearly comprehended, so far as the elementary ideas which they embody are concerned, and though their restricted scientific definition might not be realized, yet the fundamental idea would greatly assist in attaining the scientific one.

These remarks apply with peculiar force to the term "potential." Owing to the widespread interest in electrical matters there is probably no one term more commonly employed and less clearly understood than potential. We speak of the potential energy of a mass of matter which it possesses in consequence of having been raised above the surface of the earth against the attraction of gravity; of the potential energy of steam confined in the boiler; of the potential energy of oxygen and of coal, etc.; and lastly of the potential of a cell of battery, of a dynamo, and of a cloud during a thunder-storm—realizing but vaguely the connection which exists between these widely varying cases. In this busy, hurrying age, people do not stop long enough for definition, but employ words in a hit-or-miss fashion in their eager attempts at acquisition, and fail to see the beautiful relations which exist between the widely varying cases in which a term is often employed. All this is left until attainment has given leisure to go back and look up matters of detail. One of the greatest benefits which the popular scientific periodicals have conferred on the reading public has been the manner in which they have combated such superficiality by articles of clear and simple definition of matters scientific.

It is the purpose of this article to consider potential in its applications to the action of gravity, to chemical reactions, and to electromotive force as applied to electrical and magnetic phenomena. *Potential* may be provisionally defined as a *condition of stress.* Formerly the influence of attraction or repulsion which bodies mutually exerted upon each other was phrased by Newton's third law of motion. "To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed." At first these actions and reactions were considered to occur simply in space "at a distance." Clearer thought showed the absurdity of action occurring through simple space; and the necessity for a medium, the ether, as it is called, through which bodies could mutually influence each other, became apparent. Every intervening point in the ether would then be affected by this mutual play of forces. As the knowledge of natural phenomena grew the varieties of mutual actions also increased until a broad generalization was demanded, and these conditions are now expressed by the simple statement that "every action between two bodies is a stress."

Stress expresses either a condition of compression or extension, and may be clearly comprehended by reference to the behavior of springs. If a spring is extended and fastened to supports, it tends to return to its original shape, if perfectly elastic, with a force equal to that causing its extension. The supports react upon the pull of the spring to an equal extent, and both the supports and the spring are under an amount of *extension stress* equal to the *force expended* in pulling out of the spring. These same remarks apply to a spring which has been compressed instead of expanded.

We may now recognize two conditions of stress which for sake of exact reference may be classed from their *direction* of action, as positive and negative. The word potential expresses in general the ability to do or to act, a static condition due to the equilibrium of opposing forces, which once disturbed admits of the performance of a specific action. The spring as a body *acted upon* is *potential* to the amount of its condition of stress. Since a condition of stress is always due to the expenditure of energy, the resulting potential condition has a numerical value equal to the work done in producing it, and the energy so expended now exists in equilibrium as potential energy.

When the equilibrium is disturbed and the equivalent action results, the potential energy now becomes kinetic or active. Kinetic energy is a condition of stress in process of equalization. Recurring to the example of the extended spring, energy must have been expended upon it to a definite extent. In this condition it can do no work, but when released it begins to do work to the exact amount of the extension work, and the energy is kinetic in the equalization of this stress.

Thus the term potential always implies an exact amount of energy in equilibrium. Among the varieties there exist gravity or mass potential; chemical or molecular and atomic potential; electrical and magnetic potentials. Gravity or mass potential originates from the fact that all bodies of matter in the universe mutually attract each other. If the particular case of the attraction which the earth exercises upon all bodies near its surface be considered, the relations found to obtain here may be applied in general to the action of all heavenly bodies. To raise a mass of matter above the surface of the earth requires the expenditure of energy to do an amount of work that is represented by the force of the earth's attraction on the mass, multiplied by the perpendicular height to which it has been raised. In this position the body has stored in it the equivalent of this work as potential energy, the power to do a like amount of work, if allowed to fall freely. This potential energy is, then, the numerical value of the stress which exists between the body and the earth, and is measured in terms of an appropriate unit, the erg.

The erg, as a unit, is regarded as the amount of work expended in raising a unit mass against a unit attraction through a unit distance, the unit mass being designated the gramme, the unit force the dyne, the unit distance the centimetre. The dyne represents a force of such value as will, when acting continuously upon a gram mass for a second of time, increase its velocity by exactly one centimetre per second. The earth as an attracting body exercises a force or pull on bodies near its surface 981 times this unit value; or the earth's attraction on a gram is 981 dynes.

It should be here pointed out that the potential energy of a body raised above the earth must be distinguished from the potential of the earth on the body. A stone weighing 10 grammes raised to the height of 100 centimetres represents potential energy due to the expenditure of $10 \times 100 \times 981$ or 981,000 ergs of work. Now all masses raised to this height represent potential energy equal to their mass in grammes multiplied by 100 times 981 dynes. It is evident then that the latter product, 100 times 981, represents in some sense a unit condition for this particular height. Such it does in fact; and this condition defines the potential of the earth on all masses at this particular height. The potential of the earth then at a given height is the value of the energy necessary to raise a gramme mass to this elevation. For example, the potential of the earth on all masses at a height of 100 centimetres is the product of $1 \times 100 \times 981$ or 981,000 ergs or units of potential. We may now sum this up in a perfectly general statement or law, and say potential energy represents the total stress between the earth and a given body, while the potential of the earth on that body represents the unit intensity of the stress.

(To be continued.)

Electrical vs. Steam Railroads.

Lord Kelvin recently prophesied that steam locomotion may sometime be superseded by electricity, and Mr. Webb, a locomotive superintendent of a large English railway, recently stated that if the company gave instructions to have electric trains he would undertake to have one ready within two months. Commenting on these statements the London *Electrical Review* says "surely both Lord Kelvin and Mr. Webb were dreaming, and only dreaming of the substitution of electricity for the steam locomotive on trunk lines?"

A Theory of Electrolysis.

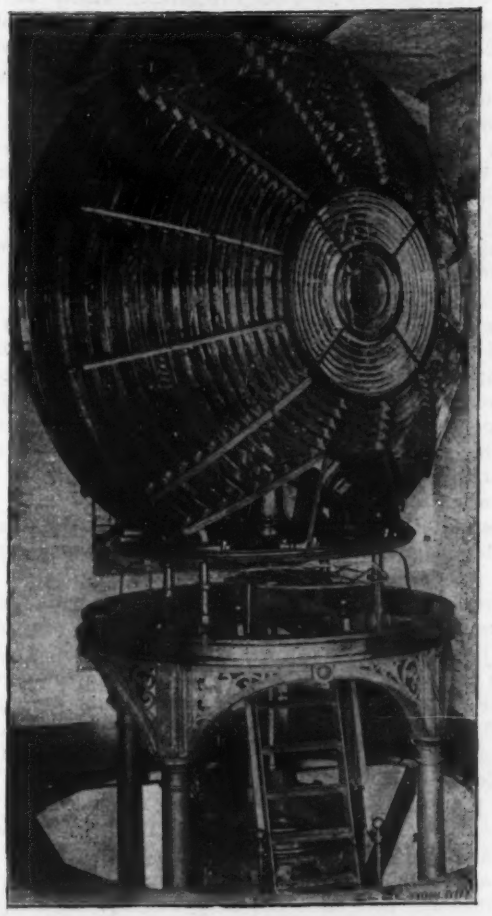
In the article by Mr. Alfred H. Bucherer under the above caption in our issue of Feb. 2 there is a misprint on the second page of the article; in the formulæ for the E. M. F.,

$$E = \frac{R\,T}{2} \log_e \frac{4\,P\,(1-x)^3\,p}{0.0819\,T\,(3-x)\,x^3 = 22.35}$$

the number 22.35 occurs as an exponent, while it should be a factor.

An Electric Lighthouse.

ALTHOUGH the first practical application of the dynamo was to lighthouse illumination, and the arc lamp for years found its only practical use in this connection, yet electric lighthouses have increased very slowly in number, and at the present time there is not one in operation in the United States. Aside from governmental conservatism, the reasons offered for this apparent neglect of electricity as a lighthouse illuminant are that its use requires expert attendance not necessary where oil is used, the danger from the light going out through an accident to the electrical machinery or other apparatus employed is greater, the cost of operation and maintenance is much larger, and the question of supplies is complicated on account of the greater quantity and variety required. On the other hand, the incontestable superiority of the electric light where great intensity is required has been recognized, though slowly, and the present tendency is to susbtitute it as an illuminant in the larger lighthouses of the world not too difficult of access, and convenient to sources of certain supply and expert inspection. The



FIRE ISLAND LIGHTHOUSE LENS.

objection that the arc light will not penetrate fog and mist as readily as light from an oil flame, while true with respect to its rays of higher refrangibility, loses its significance in view of the fact that the quantity of light which is emitted of the same refrangibility as that of the oil flame is still much greater in the ordinary lighthouse arc than the entire quantity that can be obtained from the other source.

The first lighthouse in the United States to be equipped with an electric plant will be that at Fire Island in Great South Bay. The work has long been contemplated by the Lighthouse Board, but not until now have affairs so shaped themselves as to promise an early fulfillment of the plans. Mechanically nearly everything is ready. The slow moving governmental machinery is all that intervenes between the officers in charge and a quick installation. The work is in progress, however, and the practical success of the venture will decide the question as to whether other lighthouses shall be so equipped.

Equipping old lighthouses presents some difficulties which might not be encountered if the houses were to be opened for the first time. The lighting apparatus, which may take months to install and be properly adjusted, must occupy the very same place as did the old oil lamp outfit, and yet the light cannot remain extinguished for even an hour of one night. The absence of a signal might mean very serious disaster, and a light must be displayed during the transition period. At Fire Island the difficulty is overcome by the erection of a temporary lantern just outside the regular lantern. A small staging is being built on a level with the lamp platform at the top of the house. It is braced into position, and on it will be placed a regularly equipped electric lamp, which will be in use during the months while the electrical installation is being made.

Undoubtedly the most interesting part of the new apparatus is the immense revolving lens. It is nine feet in diameter, and was made in Paris by Henri Lepaute, who exhibited it at the Chicago Exposition last year, the Government buying it at the close of the exhibition. It is a large prism affair, but, except in size, does not differ from the large lenses ordinarily made. It was originally intended to be used with a kerosene lamp, but the lighthouse board decided to substitute electric lamps. The huge clam-like arrangement weighs more than a ton, yet by means of the mercury trough in which it rests it can be rapidly revolved by a force no greater than would come from the hand of a child. This ease in manipulation is a very necessary feature, as the lens must revolve rapidly enough to give a flash every five seconds.

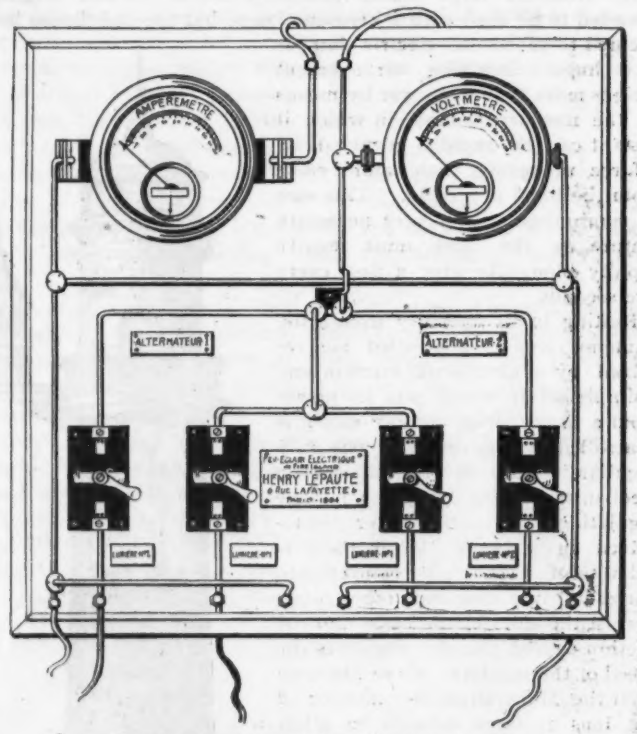
FIRE ISLAND LIGHTHOUSE, SHOWING TEMPORARY LIGHT.

Resting in its mercury trough the immense lens is controlled and revolved by a clockwork mechanism, a simple affair which gets its power from a heavy drop weight which is controlled by a governor. The only peculiar feature of this clockwork mechanism is its governor. The regulating balls of the latter are revolved in a basin. When they revolve too fast the balls, coming into horizontal line with each other, press against the sides of the basin and the friction caused thereby regulates the speed of the machine. As will be seen from the illustration the interior of the lens is large enough to allow two persons to stand within it. Here is where the electric lamp is placed, and in order to guard against the disaster which might follow a failure of one to work, there are two lamps, placed side by side. They are the ordinary Serrin lamp such as is used in nearly every French lighthouse. The two lamps rest on a turn table which is worked by a crank from the outside of the lens. For the purpose of adjustment, cleaning, or other necessary repairs, the table with the lamps upon it can be slid out at the side of the lens. It is, of course, necessary that the arc of the lamp should be directly in the focus of the lens. Should it fall below or rise above this point a great deal of the effect of the lens would be lost, as the beam of light would then tend to shoot too far up into the air, or too far down. Whenever this does occur, the fact is recorded by means of a small double convex lens placed at the side of the large lenses. This small glass projects a beam of light on to a small standard at the side of the lighthouse. On the standard is drawn a penciled horizontal line. When the arc is in the right position the small ray of light rests directly on the line. When the ray rises above or below the line, the lighthouse keeper knows that the arc of the lamp needs readjusting.

The lamps are made to carry carbons of various sizes. The diameters of those tried are 1 cm carrying 25 amperes, 16 mm carrying 50 amperes, 23 mm carrying 100 amperes, and some large ones of 4 cm carrying 125 amperes. The large ones do not give as satisfactory results as do those whose diameter is 23 mm, when measured in the photometric room, the latter giving the best result in steadiness and quality of light. The length of the arc obtained with each is 4½ mm. This length has been found to be the best for lighthouses. The difference of potential, 48 volts, is the same for all sizes.

From calculations made it has been found that the maximum light the carbons of 23 mm diameter give outside the apparatus is above 8,000 candle power, but the maximum intensity of the flash, calculated in the usual manner, is equal to from 104,000,000 to 63,000,000, depending upon the amperage, the latter figure corresponding to a maximum ray of 5,400 candles, with a special distribution of the light. These are all practical intensities allowing for a considerable drop—at least one-fifth. Were it possible to elevate the lamp high enough to overcome the convexity of the earth the maximum flash would be visible from a distance of 142 miles.

The current to the lamp is brought up through the revolving platform on which the large lenses rest, the contact, or connection, between the revolving part and the stationary part being completed by means of a small circular mercury trough, in which a steel pin



Switchboard of Fire Island Light.

travels, the connection being thus absolutely sure; the other side of the circuit is completed by a ground.

When this powerful beacon is installed in the present lighthouse on Fire Island it will change that somewhat isolated spot into an important electric station. There will be a generating house, with all its accessories, a system of underground wiring, a force of electricians, and, in fact, all the appurtenances that go with such a plant. The power house will be a corrugated iron structure, 52x24 feet in ground dimensions. Its smokestack will be 40 feet in height.

To guard against all accident, everything within the power house will be in duplicate. There will be two General Electric alternators, Type A-25, each capable of developing 7½ kw. They will be geared (friction style) to two Ideal engines, each of which can develop 25 hp if necessary, although 12 hp will be all that is needed to run the plant. The engines will be supplied with steam from Fitzgibbon boilers rated at 25 hp, and furnished by W. R. Fleming & Co., of New York.

The alternators running at 800 revolutions a minute develop a current of from 520 volts to 550 volts each, and are each excited from a small 1.5 kw exciter of 125 volts. The wiring from the power house to the lighthouse 200 feet away will be underground.

The switchboard for the lighthouse equipment has not been set up yet, but, as in the case of the other equipments, it will be in duplicate. Each side of it will contain 1 rheostat for the exciter, 1 rheostat for the arc current, 1 switch for the exciter, 1 ammeter and 1 voltmeter, 1 station transformer, and 2 lightning arresters. There will also be a polechanger and a ground detector. The switchboard for the lamps in the lens will be located in the lighthouse, of course. It is a simple affair, holding an ammeter and voltmeter and four switches, carrying each 25 amperes. The board is made by Lepaute, and was sent from France with the lens. The current to the lens lamp is controlled by means of a large water rheostat at present. Just what method of resistance will be used when the final installment is made has not yet been decided.

The experiments have so far all been made in the electrical department of the Lighthouse Board on Staten Island. The work of installing the new plant is expected to be finished in early summer. The first step will be the installing of the power station, and then will come the temporary lantern already spoken of. In this lantern will be installed an old flashing lamp with a Berjot regulator of 3,000 cp inside, which will give a flash upwards of a million cp. The duration of the flash will be the same as with the large lens—one flash every five seconds.

It may be remarked that the experiments at Staten Island show that alternating carbons do not burn equally, the under carbon being used more rapidly. The reason assigned is that there is a certain amount of draft upward, through the lenses forming a globe to the lamp, and the upper carbon is thereby subjected to a greater temperature.

The Effect of Armature Current on Magnetic Leakage in Dynamos and Motors.*

BY HARRY D. FRISBEE AND ALEX. STRATTON.

Several investigations have been recorded, which have had for their object to determine the extent and distribution of magnetic leakage in dynamos and motors, and many formulas have been deduced from a theoretical standpoint, to predict the magnitude of the stray field of a machine from its dimensions. But up to the present time, very little notice has been taken of the fact that the current in the armature usually has considerable effect on the magnetic leakage of a machine, and therefore the present experiments were made with the object of determining the nature and amount of this influence.

With this end in view, four machines were chosen, representing widely different types.

I—Crocker-Wheeler 5-hp motor (Over type).

II—Crocker-Wheeler 5-hp compound dynamo (Over type).

III—1½ kw Edison shunt dynamo (Under type or horseshoe type).

IV—2-hp Sprague motor (Consequent pole or Manchester type).

The two 5-hp machines were exactly alike in their frames and armatures, the only difference being in the winding of the field coils. This gave an excellent opportunity to make a comparison between the effect of armature reaction when opposed to a shunt field and when opposed to a compound field.

The method of investigation was to determine the flux in various parts of the magnetic circuit by means of a ballistic galvanometer. In every position of the exploring coil readings were taken, first with current in the field coil alone, and then with the maximum rated current in the armature. In the case of the compound-wound dynamo, the shunt coil only was used in the first set of readings, the series coil being thrown in with the armature for the second set. The differential coils in the Sprague motor were not used at all, as differential winding is now rarely found. The non-sparking position of the brushes was first found by running the machines fully loaded; but during the experiments the armatures were held still by a Prony brake, the current being supplied from an outside source and regulated by resistance. The galvanometer, which was a D'Arsonval ballistic, was placed in another and more quiet building a few feet away, where it gave deflections agreeing generally within one per cent., and often exactly. During the test of the two smaller machines, the period (or double swing) of the galvanometer was 7½ seconds, but this was afterward increased to 15 seconds for the two larger (5-hp) machines. It was found to be necessary to "break" the field circuit and the armature circuit independently, in order to prevent the armature short circuiting the field, and thus retarding the magnetic discharge. This was done by means of a double-pole switch, one pole of which was connected to the field and the other to the armature. The current was not reversed to overcome residual magnetism, because there would be much more error introduced than eliminated. The current impulse given to a ballistic galvanometer should be short, if it is to be measured accurately. But when the field of a machine is to be reversed, the iron must be demagnetized, and then remagnetized in the opposite direction, the latter process being much

*Graduation Thesis in Electrical Engineering, Columbia College.

slower than the former, hence the duration of the measured impulse in the galvanometer is increased enormously. It was therefor considered better to submit to the light error due to residual magnetism. Furthermore, two of the machines were run as dynamos, and the voltage due to their residual magnetism was found to be about 3 per cent. of their rated E. M. F. The error introduced was still smaller than this percentage.

In the tables the large and small letters refer to positions of the exploring coil, which are shown in the diagrams. A small letter always designates a position opposite to that represented by the corresponding large letter. Column I. gives the fluxes in various parts of the magnetic circuit, with no current in the armature, the maximum flux in the armature at no load being represented at 100. Column II. gives the same with full current in the armature, the maximum current in the armature at full load being in this case represented as 100. Column III. gives the ratio of the flux at full load divided by the flux at no load. This column cannot be found from columns I. and II. In other words, columns I. and II. merely give the relative distribution of magnetism at no load and at full load, respectively, and column III. gives the effect on the actual value of the flux when the armature current is thrown on.

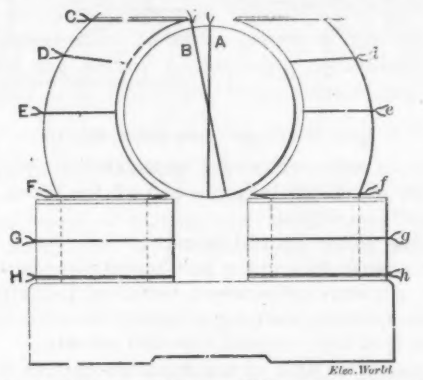


FIG. 1.—5-HP. CROCKER-WHEELER MOTOR.

Five-hp Motor. The general proportions of this machine are shown in Fig. 1. It has a large, toothed armature, with a small

TABLE I.—5-HP MOTOR.

	I.	II.	III.
A	97	97	.850
B	100	100	.8502
C	1.9	2.3	1 000
D	43.5	18.5	.362
E	58.5	33.8	.491
F	108	110	.863
G	115	120	.888
c	2 25	3.9	1.49
d	37.9	65.3	1.47
e	63.0	93.0	1.28
f	112	119	.903
g	117.3	121.5	.880
h	116.7	121.6	.885

air-gap, and the winding is of the "ring" pattern. We may therefore expect that the armature reaction will be very pronounced. The rated current is 40 amperes at 115 volts.

1. The distortion of the field in the air-gap, due to armature reaction, is very evident from the increase of flux through *d* and *e* at full load, and the corresponding decrease in *D* and *E*, as will be seen from column III. The magnetic effect of the armature current is very strong in the pole pieces, as they are close to the armature, and embrace a large arc.

2. The influence just mentioned is stronger at *D* and *d* than at *E* and *e*, showing the increase of magnetic potential toward the poles of the armature.

3. The demagnetizing turns on the armature, due to the "lead" of the brushes, produce two results. One of these is the general diminution of flux in all parts of the magnetic circuit.

4. The other result is that the leakage coefficient is greater at full load than at no load, as is evident from a comparison of column II. with column I. This increased leakage coefficient is due to two causes: 1st, the increased magnetic difference of potential between the pole pieces at full load; and 2d, the decreased useful flux.

5. The armature when loaded sucks out, as it were, the lines of force from the upper part of the coil on one side, while it blows them back and keeps them from leaking on the other side. The leakage between *F* and *G* is increased from 7 per cent. at no load to 10 per cent. at full load; while between *f* and *g* it is diminished from 5 per cent. at no load to 2½ per cent. at full load. Consequently *F* shows in column III. a decrease of 14 per cent.; but *f*, only 10 per cent.

6. The flux through *c* is increased, showing that the armature attracts lines of force from the upper part of one pole piece.

Five-hp Dynamo.—The figure and description given of the 5-hp shunt motor apply equally well to this machine, the only difference

TABLE II.—5-HP DYNAMO.

	I.	II.	III.
A	100	94.1	1.178
B	98.7	100	1.268
C	5.19	5.74	1.359
D	37.8	23.1	.764
E	63.2	45.3	.897
F	117.9	120.8	1.282
G	122.2	129.4	1.325
H	123.9	130.0	1.313
c	4.57	6.63	1.815
d	41.3	61.7	1.870
	61.3	85.2	1.739
e	110.7	121.0	1.367
g	115.2	125.4	1.362
h	117.0	127.6	1.353
x	0.14	.....	.....

between the two being that the field of the dynamo is compound wound.

1. The general increase of flux at full load is of course due to the compound winding; and if allowance be made for this fact, it will be seen that the reaction of the armature produces substantially the same results as in the 5-hp motor.

2. Notes 1 and 2 on the motor apply equally well to the dynamo. In column III. *d* and *e* show an enormous increase, while *D* and *E* show a decrease, in spite of the increase of flux everywhere else.

3. The armature flux is increased less than the flux through any other part of the magnetic circuit, and the leakage coefficient is increased much more than in the motor. In a compound-wound dynamo, besides the effect of the back ampere-turns on the armature (mentioned in Note 4 on the motor) there is a greater magnetic difference of potential between any two parts of the magnetic circuit at full load than at no load. The useless flux through the air is increased proportionally, while the useful flux through the iron is not increased nearly so much, owing to the decreased permeability at higher magnetic density.

4. The phenomenon mentioned in Note 5 on the motor appears also in the dynamo. There is a greater increase in *f* than in *g* and

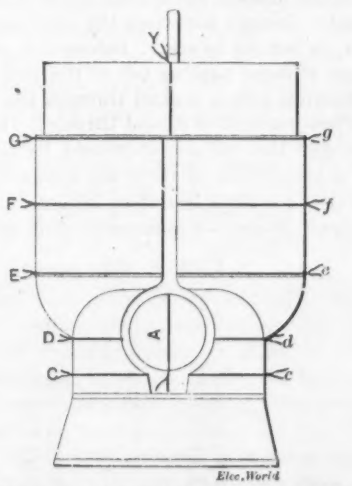


FIG. 2.—1-5-KW. EDISON DYNAMO.

h, but a smaller in *F* than in *G* and *H*. But the leakage between *f* and *g* does not seem to have been decreased, probably because of the general increased leakage at full load.

5. Note 6 on the motor applies to this machine also. The increase in *c* is enormous.

6. The leakage from the base to the armature, through one of the pedestals and shaft, was tested, but was found to be insignificant (see *x*, column I.). This is because the parts of the magnetic circuit which they connect are of equal potential. Yet there is quite a little leakage from the field coils and pole pieces to the bearings, as may be shown by touching them with a screw-driver.

7. The flux through *F*, *G* and *H* is greater than in *f*, *g* and *h* at no load, but smaller at full load; and the increase of flux is greater in *f*, *g* and *h* than in *F*, *G* and *H*. Probably the iron was harder on the side where the increase is smaller. At no load,

the leakage between the pole piece and the base is greater on the hard side, because the flux produces a greater difference of potential in the hard iron; but as the softer iron allows more magnetism to pass through it in proportion to a greater magnetizing force, the leakage between pole piece and base becomes greater on the soft side at full load.

TABLE III.

	I.	II.	III.
A	100.0	100.0	1 000
C	17.4	16.7	.959
D	73.9	67.1	.909
E	142.9	142.9	1.000
F	156.6	156.9	1.002
G	155.9	155.0	.998
c	20.0	20.7	1.034
d	75.1	81.6	1.087
e	145.7	144.8	.994
f	157.1	158.1	1.006
g	159.6	158.6	.994
y	154.0	152.9	.993

Edison 1.5 kw dynamo.—Horse-shoe type. At full load this machine gives 12 amperes at 125 volts. The armature reaction is evidently insignificant. This is to be expected for the following reasons.

1. The armature is of small diameter and has few ampere turns relatively to those of the field magnet.

2. Large air-gap. The armature has a smooth core, wound with four layers of conductors, giving a total air-gap of nearly ¾ inch. It is evident that in such a construction the difference of magnetic potential between the pole pieces is so great that the ampere turns on the armature can have but little effect.

3. Drum winding. As is well known a drum wound armature usually has less armature reaction than a ring armature.

A glance at the table will show that the flux through the different sections of the field magnet remained practically constant except in the pole pieces, where the armature current caused a distortion of the field. This is well shown by the increased flux through the coil *d*, and the corresponding decrease through coil *D*, when the armature current was present.

The increased leakage through coil *c* and decrease in the leakage through coil *C* shows that one pole tip had become highly saturated, while the other pole tip was correspondingly relieved.

The leakage coefficient is large.

Leakage coefficient—No load = 1.596.

Leakage coefficient—Full load = 1.586.

The change in the leakage coefficient is quite remarkable, as an increase is usually looked for when the machine is loaded. The reason, however, is not far to see. Before the machine was loaded many of the lines of force passing out of the end of the pole piece, through the exploring coil *c*, leaked through the base to the other pole piece. When current is passed through the armature coils, the leakage through the coil *c* is increased by the distortion of the field, but most of these lines of force are drawn into the armature so that the leakage is a little less than before.

Two-hp Sprague Motor.—Consequent pole or Manchester type.

TABLE IV.

	I.	II.	III.
A	100 00	92 50	.981
B	94.90	100 00	1.117
C	*4 29	24.00	5 857
D	59.60	64.61	1.042
E	85 10	81.83	1 022
F	89 40	84.80	1 007
G	86.00	77.20	.952
H	77.00	67.25	.951
c	*4.47	†16.91	3.931
d	57.20	51.47	.957
e	80.10	73 10	.969
f	86.30	82.70	1 018
g	81.90	81.30	1.053
h	70.80	69.03	1.036
x	22 79	21 37	.993
y	27.35	25.10	.997

* These readings not necessarily zero, as the centre of the consequent pole geometrically is not necessarily its centre magnetically.

† Induction actually reversed by armature reaction.

This machine at full load gives 17 amperes. The reactions in this type are very marked.

1. There is a great change in the flux through coils *c* and *C* where the field is much distorted by the armature current.

2. The leakage from the bearings is excessive, being 50 per cent. of the maximum flux through the armature at no load, and 46 per cent. of the maximum flux through the armature at full load.

Of course some of this leakage is merely apparent, as many of the lines of force get back to the armature but most of them are to be considered as absolute leakage.

Column III. shows that the leakage was slightly decreased from the bearings when the machine was loaded.

3. *Leakage coefficient*—No load = 1.76.

Leakage coefficient—Full load=1.68.

It is most remarkable that the armature reaction actually increased the useful flux. This is due to two causes.

(*a.*) The armature was probably not highly saturated.

(*b.*) Many of the lines of force, instead of going through the pole pieces against the opposition of the armature reaction, poured into the armature from the field coils.

This is shown to be the fact by the increased flux through the middle of the field coils when the machine was loaded, while at the exploring coils *G* and *e* the flux was considerably decreased.

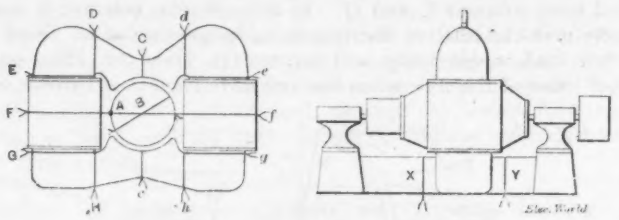


FIG. 3.—2-HP. SPRAGUE MOTOR.

General Conclusions.—A careful consideration of the machines shows that similar actions take place in all the types, the difference being principally in degree.

The following points are of interest:

1°. The change of flux in the pole pieces when current was passed through the armature coils caused increased induction in one pole piece and corresponding decrease of induction in the other, this being the case even with the compound wound machine.

2°. The magnetic effect of the armature current is more marked in machines which have { (*a.*) Armatures of large diameter. (*b.*) Ring winding.

3°. With a large air-gap, as in smooth core armatures, the coefficient of leakage is very large, but this coefficient is less affected by armature reaction.

Conversely—With small air-gap, as in toothed armatures, the coefficient of leakage is small, but this coefficient is more affected by armature reaction. Freedom from armature reaction means large increase in the ampere turns on the field.

4°. With proper construction of the pole pieces, armature reaction is not such a thing to be dreaded; that is, if the air-gap provides ample space for the shifting of the lines of force consequent on loading the machine, the armature reaction does not cause marked trouble. Indeed, this same armature reaction can be made to keep the speed of a motor constant under all loads, or the motor can even be made to increase its speed with the load. In short, the advantages of differential winding can be obtained in a simpler way, and without the danger of entirely destroying or even reversing the field magnetism when the motor is overloaded.

This may be inferred from the fact that the 5-hp C. W. motor, before mentioned, was made to increase its speed considerably at full load by inserting resistance in the field winding, thus weakening the magnet. The same action would undoubtedly take place if the pole pieces were so shaped as to partially throttle the lines of force when the field was distorted by armature reaction.

Interior Conduit Litigation.

The United States Circuit Court of Appeals, Judges Lacombe, Wallace and Shipman presiding, on January 22 confirmed the decision of Judge Coxe in the case of the Interior Conduit Company against the Eureka Electric Company. The decision of Judge Coxe was rendered last spring, the points directly in controversy being the placing of a pair of wires, each wire forming one side of an electric lighting circuit, into a pipe made of insulating material, a safety catch being interpolated in said circuit. The opinion of Judge Coxe stated that if the construction broad enough to cover the defendant's structures is placed upon the above claims they must be held invalid. If limited to a complete system of pipes extending continuously through the building, "from supply to consumption," the claims may be upheld. But the defendant, he stated, does not employ such a system, and in no event is the third claim infringed for the reason that the defendant does not use a pair of wires twisted together.

Electrical Power Transmission—XIII.

BY LOUIS BELL, PH. D.

Ohm's law is the basis of all computations regarding the line, and lies behind all the formulæ used for this purpose. The most obvious way of applying it would be to find the resistance of the whole line corresponding to any required current and loss of volts, and then to look up in a wire table the wire which when taken of the required length woud give this resistance. As a matter of convenience in computation a large number of formulæ have been devised which include the distance, loss, expressed either in volts or percentage lost, energy transmitted, in watts, horse-power and the like, and various other factors, which may be convenient for particular applications. Some of them give the total weight of copper required and others the area of the conductor expressed in various ways.

Of these formulæ, all modified from Ohm's law to suit various conditions, the most generally convenient are those which give the area of the required conductors in "circular mils" (*i. e.*, circles one one-thousandth of an inch in diameter), a barbarous unit familiar in all tables of wire sizes, which unfortunately has obtained too firm a hold on electrical practice to be readily shaken off.

Of these "circular mil" formulæ one is subjoined which has been found by the author to be most convenient on account of its simplicity. It is derived from Ohm's law as follows:

$R = \frac{E}{C}$. Now for any length of wire $R =$

$$\frac{\text{Total length in feet} \times \text{resistance of 1 foot wire 1 mil in section}}{\text{Area in circular mils.}}$$

Taking the total length of wire as twice the distance of transmission in feet, since this distance is particularly in mind, and noting that the resistance of one "mil-foot" of commercial copper wire is quite nearly 11 ohms, we have

$$R = \frac{2\,D \times 11}{c.\ m.}$$

Substituting this value of R in the expression of Ohm's law just noted, and solving for the value of $c.\ m.$ we have,

$$c.\ m. = \frac{2\,D \times 11 \times C}{E}$$

In this expression E is the number of volts lost, and 11 is taken as the "mil-foot" constant, since it is large enough to take account of variations in diameter of wire, bad joints, flaws, and the like. The theoretical value is nearer 10.8, but experience has shown the wisdom of making the above allowance.

Having found in any case the area of the required wire in circular mils, its size and weight per thousand feet can be looked up in any wire table.

As a matter of convenience, the following table is inserted, giving, for the sizes of wire most used in power transmission work, the area in circular mils, the diameter, resistance per thousand feet, and weight per thousand feet, both bare and with insulation of the so-called "weatherproof" grade, which is well adapted for ordinary line work. Diameters are here given to the nearest mil, areas to the nearest 10 c. m., and weights to the nearest pound to facilitate reference. The table is not continued beyond the size given, because anything larger than No. .0000 is exceedingly troublesome to string, and when called for is better replaced with two smaller wires. On the other hand, wire smaller than No. 6 is seldom indicated by the conditions and produces a mechanically weak line.

Circular Mils.	Gauge No. B. & S.	Diameter in Mils.	Resistance per M feet.	Wt. per M feet Bare.	Wt. per M ft. We'th'rproof
211,600	0000	460	.04904	640	725
167,800	000	410	.06184	508	580
133,100	00	365	.07797	403	480
105,600	0	325	.09827	320	375
83,690	1	289	.12398	253	307
66,370	2	258	.15633	201	245
52,630	3	229	.19714	159	195
41,740	4	204	.24858	126	147
33,100	5	182	.31346	100	121
26,250	6	162	.39528	79	99

The above formula and table give sufficient data for computing the general character of a transmission line provided the loss in volts is determined. In actually working out the amount of copper needed in any given case certain details require to be taken into account which will be discussed later.

A glance at the formula shows that the voltage employed is the determining factor in the cost of the lines. For a fixed percentage of loss doubling the working voltage will evidently divide the amount of copper required by four, since the current for a given amount of energy will be reduced by one-half, while the volts lost will be doubled.

So in general the amount of copper for transmitting a given amount of energy a given distance at a fixed efficiency will vary invariably as the square of the voltage.

If the distance of transmission be doubled the area of the conductor will evidently have to be doubled also; consequently, since the length is doubled, the weight of copper will be increased four times. That is for the same energy transmitted at the same per cent. efficiency and voltage, the weight of copper will increase directly as the square of the distance. The advantage and, indeed, necessity of employing high voltages for transmissions over any considerable distance are obvious. In fact, it will be seen that by increasing the voltage in direct proportion to the distance the weight of copper required will be made a constant quantity independent of the distance.

If one were free to go on increasing the voltage indefinitely without enormously enhancing the electrical difficulties, power transmission would be a simple task, but unfortunately such is not the case. With very high voltages we meet difficulties both in establishing and maintaining the insulation of the line and in utilizing the power after it is successfully transmitted. The specific character of these limitations will be discussed later, but enough has been said to render it evident that in establishing a power transmission system both the working voltage and the volts lost in the line must be determined with great judgment.

In the matter of economy in the line, high voltage is desirable—first, last and always. In systems where the voltage undergoes no transformation its magnitude is somewhat arbitrarily fixed by the practicable voltage which can be employed in the various translating devices, motors, lamp and the like. For example, in a system at constant potential wherein incandescent lamps are an important item, 125 volts or 250 volts worked on the three-wire system would be the highest pressure advisable for the receiving system in the present state of the art. For a direct-current-motor system the corresponding figure would be 500 to 600 volts or 1,000 to 1,200 three-wire. Similar limitations indicated elsewhere will hold for other classes of apparatus.

When there is a transformation of voltage in the system, whether direct or alternating curren , so that the line voltage is not fixed by that of the translating devices, it is advisable to raise the voltage of transmission as high as the existing state of the art permits. It must be borne in mind, however, that this general rule is subject to modification by circumstances. It would be bad economy, for instance, to use very high pressures and costly insulation for a transmission of moderate length and trifling magnitude. Such practice would result in sending perhaps 100 kw over a line or through a conduit which could as easily serve for ten times the power without great additional cost for copper. It is well, however, not to stop at half-way measures, but if transforming devices are to be used at all, to go boldly to the highest voltage which experience has shown to be safe on the line, or in the generators if only reducing transformers are used.

For example, in most cases of alternating current work, 1,000 volts is of doubtful utility—if the line voltage has to be reduced at all it is better to get the advantage of 2,000 to 5,000 volts on the line—if raising transformers are employed the latter figure might as well be increased to 10,000 unless climatic or other special conditions are unfavorable.

It will be seen that quite aside from engineering details, divers really commercial factors must enter into any final decision regarding the voltage to be used. And these commercial factors are the final arbiters as to the working voltage, and even more completely as to the proportion of energy which it is desirable to lose in the line. Power transmission systems are installed to earn money, not to establish engineering theses.

It is evident to start with that whatever the voltage, high efficiency of the line and low first cost are in a measure mutually exclusive. The former means large conductors, the latter small ones; the former delivers a large percentage of salable energy with a high charge for interest on line investment; the latter a smaller amount of energy with a lessened interest account against it. At first sight it would seem easy to establish a relation between the cost of energy lost on the line and the investment in copper which would be required to save it, so that one could comfortably figure out the conditions of maximum economy.

In 1881 Lord Kelvin, then Sir William Thomson, attacked the problem and propounded a law, known often by his name, which put the general principles of the matter in a very clear light, but incidentally has been responsible for not a little downright bad engineering.

He stated, in effect, that the most economical area of conductor will be that for which the annual interest charge equals the annual cost of energy lost in it.

While it is true that for a given current and line Kelvin's law correctly indicates the condition of minimum cost in transmitting said current, this law can only mislead when applied to concrete cases of power transmission, for it omits most of the important considerations. It involves neither the absolute value of the working voltage nor the distance of transmission, and for long transmissions at moderate voltage gives absurd values for the energy lost. Indeed, as it deals directly only with the most economical condition for *transmitting* energy, it quite neglects the amount of energy delivered. In fact, one may apply Kelvin's law rigidly to a concrete and quite possible case and find that no energy at all will be obtained at the end of the line.

In other words, Kelvin's law while a correct solution of a particular thesis is in its orginal form totally inapplicable to power transmission problems.

Various investigators, notably Forbes and Kapp, have made careful and praiseworthy attempts to so modify Kelvin's law as to take account of all the facts; indeed, nearly every writer on power transmission has had a shy at the problem.

Perhaps the commonest attempt at improvement is to follow the general line of the original law but equate the interest charge on copper to the annual *value* of the power lost; in other words, to proportion the line by increasing the copper until the annual net value of a horse-power saved in the line would be balanced by the interest charge on the copper required to save it. This proposition sounds specious enough at first hearing. Practically, it produces a line of far greater first cost than is usually justified. It is evident that the possession of a few extra horse-powers thus saved brings no profit unless they can be sold, and in very few cases is a plant worked close enough to its maximum capacity during the earlier part of its existence to render a trifling increase in efficiency of any commercial value. When the plant is worked at a very high cost for power or soon reaches its full capacity a few horse-powers saved in the line may be valuable; but far oftener, especially in water-power plants, it would be cheaper to let the additional copper wait until the necessity for it arises. Furthermore, it evidently does not pay to so increase the line investment that the last increment of efficiency will bring no profit.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXVI.

BY ALFRED E. WIENER.

In a very interesting paper entitled "On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-Electric Machinery," Prof. Harris J. Ryan[1] has demonstrated the importance of making the pole pieces of such shape that saturation at the pole corners cannot occur even at full load; for the armature ampere turns cannot change the total magnetization established by the field when the pole corners are unsaturated. He further proved by experiment that for a sparkless operation at all loads of a constant current generator it is necessary that the air gap be made of such a depth that the ampere turns required to set up the magnetization through the armature without current and for the production of the maximum E. M. F. of the machine shall be a little more than the ampere turns of the armature when it furnishes its normal current. As long as the brushes were kept under the pole faces the non-sparking point was wherever the brushes were placed, no matter whether the armature core was saturated or not.

In order to enable currents to be taken from a machine at various voltages, W. B. Sayers has proposed to subdivide the pole faces by deep, wide slots parallel to the armature shaft, Fig. 117, thus providing a number of neutral points on the commutator, at which brushes may be placed without sparking. If, for instance, there are two such grooves in each pole piece, the total voltage of the machine is divided into three equal parts, and by employing an intermediate brush at one of the additional neutral spaces, two circuits can be supplied by the machine, one each between the intermediate brush and one of the main brushes, one having two-thirds and the other one-third of the total voltage furnished by the dynamo.

[1]Transactions A. I. E. E., Vol. VIII., p. 451 (Sept. 22, 1891); THE ELECTRICAL WORLD, Vol. XVIII., p. 252 (Oct. 3, 1891).

Chapter 45.—Base, Zinc Blocks, Pedestals and Bearings.

(*a*) *Base.*

The *Base* is the only part of the machine where weight is not only not objectionable but very beneficial, and it should therefore be a heavy iron casting, especially as the extra cost of plain cast iron is insignificant as compared with the entire cost of the machine. A heavy base brings the center of gravity low, and consequently gives great stability and strength to the whole machine.

Besides this mechanical argument in favor of a massive casting there is a magnetical reason which applies to all types in which the base constitutes a part of the magnetic circuit, as is the case in the inverted horseshoe type, Fig. 68, in the vertical single magnet type, Fig. 73, in the inclined and vertical double magnet types, Figs. 78 and 79, respectively, in the iron-clad types, Figs. 83, 85, 86, 87, 98 and 99, respectively, and in the vertical quadruple magnet machine, Fig. 104. In these and similar types a heavy base of consequent high permeance reduces the reluctance of the entire magnetic circuit and effects a saving in exciting power which usually is sufficient to repay the extra expense involved, and often even reduces the total cost of the machine.

If the base forms a part of the magnetic circuit of the machine, constituting either the yoke or one of the pole pieces, its least cross-section perpendicular to the flow of the magnetic lines should be dimensioned by the rules given for cast iron magnets, that is, it should be at least 1⅔ to 2 times the area of the magnet cores, if the latter are of wrought iron or cast steel, and at least of equal area if they are of the same material as the base, *i. e.*, of cast iron.

(*b*) *Zinc Blocks.*

In some forms of machines, such as the upright horseshoe type, Fig. 67, the horizontal single magnet types, Figs. 71 and 72, the consequent pole, horizontal double magnet type, Fig. 77, the tangential multipolar type, Fig. 90, etc., the magnet frame rests upon two pole pieces of opposite polarity, and if these were joined by the iron base the latter would constitute a stray path of very much lower reluctance than the useful path through air-gaps and armature, and the lines of force emanating from these two pole pieces would thus be shunted away from the armature instead of forming a magnetic field for the conductors. In order to prevent such a short-circuiting of the magnetic lines it is necessary either to use material different from iron for the base, or to interpose blocks of a non-magnetic substance between the pole pieces and the bed plate. The former method can be applied to small machines only, and in this case the magnet frame is mounted upon a base of either *wood* or *brass*. For large machines a wooden base would be too weak and too light, and a brass one too expensive, and resort has to be taken to the second method of interposing a magnetic insulator, *zinc* being most usually employed. These zinc blocks must be of the necessary strength not only to carry the weight of the frame but also to withstand the tremor of the machine, and must be made high enough to introduce a sufficient amount of reluctance into the path of leakage through the base. The reluctance required in that path must be at least 4 times, and preferably should be up to 10 or 12 times that of the air-gaps; that is, its relative per-

TABLE LIV.—HEIGHT OF ZINC BLOCKS FOR HIGH-SPEED DYNAMOS WITH SMOOTH-CORE DRUM ARMATURE.

Capacity in Kilowatts.	Diameter of armature core (from Table VIII.)	Height of winding space (from Table XV.)	Height of Binding.	Radial clearance (from Table XLVIII.)	Radial length of gap space. Inch.	Ratio of Height of zinc block to length of gap space.	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux.
1	3¼″	.3″	.03″	.045″	.375″	5	1⅜″	25
2	3¾	.325	.03	.045	.4	5	2	25
3	4⅛	.35	.03	.045	.425	5⅛	2⅛	25
5	5¼	.375	.03	.045	.45	5½	2⅜	20
10	6	.4	.04	.06	.5	5½	2¾	20
15	6¾	.425	.04	.06	.525	6	3⅛	18
20	7⅛	.45	.04	.06	.55	6¼	3⅜	18
25	8¼	.475	.04	.06	.575	7	4	16
30	9	.5	.05	.075	.625	7¼	4½	16
50	10½	.525	.05	.075	.65	7⅝	5	15
75	12½	.55	.06	.09	.7	8⅛	6	14
100	15	.6	.06	.09	.75	8⅝	6½	14
150	18⅛	.65	.065	.125	.84	9	7½	12
200	22⅛	.7	.07	.16	.93	9¾	9	10
300	28	.8	.07	.19	1.06	10½	11	10

meance calculated from formula (114), chapter 38, according to the size of the machine, should range between ¼ and ½ of the relative permeance of the air-gaps as found from formula (126) or (127), chapter 39, the amount of leakage through the iron base being thereby limited to 25 per cent. of the useful flux in small dynamos, and to 8 per cent. in the largest machines.

This condition is fulfilled if the height of the zinc blocks, according to the kind and the size of the machine, is from 3 to 15 times greater than the radial length of the gap space. The following tables LIV., LV., and LVI., give the value of this ratio, the consequent height of the zinc blocks, and the corresponding approximate leakage through the base for high-speed dynamos with smooth-core drum armatures, for high-speed dynamos with smooth-core ring armatures, and for slow-speed machines with toothed and perforated armatures, respectively:

TABLE LV.—HEIGHT OF ZINC BLOCKS FOR HIGH-SPEED DYNAMOS WITH SMOOTH-CORE RING ARMATURES.

Capacity in Kilowatts.	Diameter of armature core (from Table IX.)	Height of winding space (from Table XV.)	Height of Binding.	Radial clearance (from Table XLVIII.)	Radial length of gap space. Inch.	Ratio of Height of zinc block to length of gap space.	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux.
1	7″	.25″	.03″	.045″	.325″	8	2⅝	15⅝
2	8	.25	.03	.045	.325	9	3	14
3	9½	.275	.04	.06	.375	9½	3½	14
5	11	.3	.04	.06	.4	10	4	12
10	14	.325	.05	.075	.45	11	5	12
15	15	.325	.05	.075	.45	11	5	12
20	16	.35	.06	.09	.5	12	6	10
25	18	.35	.06	.09	.5	12	6	10
30	20	.375	.07	.13	.575	12	7	10
50	24	.4	.07	.13	.6	13½	8	9
75	28	.425	.07	.155	.65	14⅛	9½	9
100	32	.45	.07	.155	.675	15⅛	10⅛	8
150	36	.475	.07	.18	.725	16	11½	8

TABLE LVI.—HEIGHT OF ZINC BLOCKS FOR SLOW-SPEED DYNAMOS WITH TOOTHED AND PERFORATED ARMATURE.

Capacity in Kilowatts.	Diameter of armature core (from Table X.)	Height of winding space (from Table XVI.)	Radial clearance (from Table XLVIII.)	Maxi n. Radial length of gap space. Inch.	Ratio of height of zinc block to max. length of gap space.	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux.
2	12″	1⅛″	⅛″	1⅛″	3	3⅜″	15⅝
3	15	1¼	⅛	1⅛	3	4	15
5	17	1⅜	⅛	1⅛	3½	5	12
10	21	1½	⅛	1⅛	3¾	6	12
15	23	1⅝	⅛	1⅛	4	6¾	10
20	25	1¾	⅛	1⅛	4⅛	7½	10
25	27	1¾	⅛	1⅛	4⅛	8	10
30	30	1⅞	⅛	1⅛	4⅛	8¾	8
50	36	1⅞	⅛	2	4¾	9½	8

From the comparison of the above tables LIV., LV. and LVI., it follows that the height of the zinc blocks increases in a nearly direct proportion with the diameter of the armature-core, and

TABLE LVII.—COMPARISON OF ZINC BLOCKS FOR DYNAMOS WITH VARIOUS KINDS OF ARMATURE.

Diameter of Armature Core.	Height of Zinc Blocks.		
	Smooth Armatures.		Toothed and Perforated Armatures.
	Drum.	Ring.	
Inches.	Inches.	Inches.	Inches.
3	1¾	....	....
4	2	....	....
6	2¾	2	1¾
8	4	3	2½
10	5	3½	3
12	5¾	4⅛	3½
15	6½	5	4
18	7½	6	5
21	8¾	7	6
24	9¾	8	7
27	11	9	8
30	....	10	8¾
36	....	11½	9½

that, for the same armature diameter, a smooth drum machine requires a higher and a toothed or perforated armature machine a lower zinc than a smoothering dynamo. By compiling the results of tables LIV., LV. and LVI., the above table LVII., is obtained, from which can be seen that the heights of zinc blocks for smooth-ring machines are from 18 to 30 per cent. less than for smooth-drum dynamos, and those for machines with toothed and perforated armatures are from 11 to 20 per cent. less than for smooth-ring armature dynamos.

(To be Continued.)

Electric Shock from a Secondary Alternating Circuit.

To the Editor of The Electrical World:

SIR:—In my opinion discussion of the possible danger to life from electric current supplying incandescent lamps should be well considered before being given to the public, and, on the other hand, attention should be called to conditions that may not be generally understood.

In the case mentioned in your issue of Jan. 19, it appears that a fatal shock was received by a man standing with bared feet on damp earth while lighting a lamp supplied from a 52-volt alternating secondary circuit; that before and after the accident the lamps burned as usual, and the only faults discovered was a slight ground on the secondary circuit; and that the insulation was destroyed at one point in the transformer between the primary and secondary wires. In stating that no other faults were discovered, it is fair to assume that the primary circuit was tested for "grounds" and found clear *as usual*, but it is a fact that a ground detector always shows a slight leakage; if it is small, and the same on both sides of the line, then the condition being normal, it is regarded as clear.

Numerous opportunities exist for slight leaks throughout any system of distribution, and in the case of the primary lines of an alternating system exceptionally favorable conditions for leaks exist by reason of the numerous transformers and their connections. The "insulated" line wire offers many opportunities for slight escapes in trees and similar places where the resistances may be sufficiently high to prevent a serious leak or one which would be called a ground. When the man connected one side of the primary line to earth through the defective transformer over a comparatively low resistance (the secondary circuit and his body) all the leaks on the other side of the line acted collectively to establish a circuit of sufficiently low resistance to permit enough current to pass to be dangerous, and not enough to overload the fuses in the transformer or branch of secondary.

If your correspondent has any doubt as to this being the manner in which it occurred let him connect a 52-volt lamp between one side of the primary line and the earth—establishing a good connection with the earth—and note the result.

JAS. I. AYER.

NEW YORK, N. Y.

To the Editor of The Electrical World:

SIR:—In reference to the article in THE ELECTRICAL WORLD of Jan. 19 concerning a colored man who was killed by contact with a 52-volt circuit, I would say that I find lamps will burn on a converter and no fuses blow or lamps burn out and yet have the primary in connection with secondary, through ruptured or defective insulation. In a transformer where the primary is in contact with the secondary a test will show 1,000 volts, or whatever the primary is, if a voltmeter be connected, one terminal to the secondary and the other to a good ground; or twenty 50-volt lamps connected in series will burn if connected as above. We have several converters in our station at present having this defect, and I have at several different times made the above test. The fuse would blow and the lamps burn out if the defective wiring were on a fixture connected with gas piping if primary should be connected with the secondary as I have seen demonstrated in practice. No change would be noticed in an installation of lights if there were no ground on the secondary and no access to the ground through gas or water pipes, but it would seriously affect a person standing on ground and making connection with the secondary.

L. H. THULLEN.

LEETONIA, O.

To the Editor of The Electrical World:

SIR:—Referring to the communication in a recent issue of THE ELECTRICAL WORLD from a correspondent in Demerara in regard to a fatal shock from a secondary alternating main, we have had a dozen or more similar experiences during the past six years, though none has resulted fatally.

In one instance our lineman went into a damp cellar to do repairing, and upon taking hold of the socket of an ordinary cord drop he received a violent shock, throwing him down, breaking the cord and burning his hand badly. Upon examining the transformers in such cases we always find a "nigger" between the first few turns of the primary and the secondary, in most cases welding the copper slightly together.

In all cases the lamps continued burning as usual, and trouble was discovered only upon some one receiving a shock.

These troubles with us usually follow a severe thunder storm, where the lightning puncturing the insulation gets to ground through the secondary wiring.

Our system of lines is rather extended, both primary and secondary, running through thickly shaded streets, and in damp weather always show considerable leak to ground.

J. B. FOOTE.

JACKSON, Mich.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of Multiphase Motors.—The "Elek. Zeit.," Jan. 24, contains the first half of an article by Mr. Cahen, in which he gives a combined graphical and analytical method which is simple and more convenient than either of the other two used separately and which can be used in practice; it is in agreement with the method in the latest edition of Kapp's work on the transmission of power.

Theory and Calculation of Non-Synchronous Motors.—The paper of Mr. Legrand is continued in "L'Eclairage Elec.," Jan. 12.

A New Mining Motor.—The first part of a paper by Mr. Henry A Mavor read before the Institution of Engineers and Ship Builders in Scotland is reprinted in the Lond. "Elec. Eng.," Jan. 25; it is quite elementary in character; an abstract of some length including the last part of the paper with illustrations of the motor is published in "Ind. and Iron," Jan. 25.

Phonograph Motor.—Detailed data, including windings, etc., of this motor running with 2½ amperes and 2 volts are given in the Lond. "Elec. Rev.," Jan. 25.

Lindner Dynamo and Portable Motor.—A brief, illustrated description is published in "Ind. and Iron," Jan. 25; (judging from the proportions of the dynamo it is of no special interest).

Dynamo Safety Device.—An apparatus intended to protect dynamos from damage due to grounds, crosses, etc., is described and illustrated in the "Elec. Eng.," Feb. 6; the principle is to form an auxiliary broken circuit which offers a less resistance than the insulation of the machine, thus being always ready to take the abnormal charge; the break in the auxiliary circuit is provided with carbon points, one connected to the field of the machine (presumably a constant-current arc light machine) and the other conrected to the frame. To ascertain where the trouble has occurred the carbons are separated and an electric contact is made from any part of the frame to the brushes; if a current exists it is the insulation of the machine that has been punctured, and if not, the trouble is in the circuit.

Magnetic Brush-Holder.—A form devised by Mr. Henry is described and illustrated in the "Elec. Eng.," Feb. 6; the carbon brush is pressed against the commutator by an iron core in a coil through which the main current passes; the pressure is therefore proportional to the load on the motor.

LIGHTS AND LIGHTING.

The Electric Arc.—The paper by Mrs. Ayrton (see Digest last week) is continued in the Lond. "Elec.," Jan. 25; it includes numerous tables and curves. A set of curves shows the general character of the changes in the curves caused by varying the diameters of the carbons; the chief one is the change in the smallest current which causes hissing; with both carbons solid, hissing occurs with a much smaller current for a given length of arc than when the positive carbon is cored; "even with the same pair of carbons the smallest current with which continuous hissing first takes place, and the largest current with which a silent arc can be maintained continuously for a given length of arc, are almost impossible to determine with absolute certainty." Hissing always occurs with very much smaller currents with the smaller carbons than with the larger ones; the largest current which can maintain a silent arc of given length, that is, the hissing point, increases with the cross section of one or both of the carbons; the voltage has always gained a fairly constant value before hissing begins, and it is constant for a much larger range of current before hissing begins with large carbons than with small; therefore if the object is to keep the voltage constant for a large range of currents large carbons should certainly be used. One of the figures shows that the largest current which can maintain a silent arc with given carbons is greater for long arcs than for short ones, that is, if with a certain length of arc there is hissing then by lengthening the arc and keeping the current constant it will become silent. The two following conclusions are arrived at: 1. "The smallest current which produces hissing with a given length of arc increases with the cross-section of the carbons. 2. The smallest current which produces hissing with a given pair of carbons increases with the length of arc." From some of the figures it appears that increasing the cross-section of the carbons has more effect in increasing the current that can flow without hissing, than increasing the length of the arc in the same ratio. Regarding silent arcs it is stated that the permanent value of the voltage for a given current and length of arc depends but little on the cross-section of the carbon. Curves connecting the voltage with the current show that the curve for a cored positive carbon is from 3 to 6 volts lower than with a solid positive; this diminution of voltage is not uniform with the length of the arc as it is much greater with short arcs and with smaller currents. Curves connecting the apparent resistance with the length of the arc are shown; the simple formula of Cross and Shepard for this resistance agrees with these results with solid carbons, but for cored positives no such equation is correct. Measurements of the depths of the craters were made and it was found that with a given current the depth is greater the shorter the arc; the influence of this depth on the apparent resistance is greatest with arcs less than 3 mm, and the two may be connected; the soft core may volatilize more easily, diminishing the voltage, or it may increase the amount of volatile carbon given off per second and thereby increase the cross-section of the conducting medium; she believes that the core acts in both of these ways; the widths of the craters were also measured and were found to vary very slightly with the length of the arc for a given current; for a given length the width of the crater minus a constant varies as the current; a simple formula is given; the diameter of the crater does not vary directly as the current, as stated by Prof. Thompson; the width of the crater can have very little influence, if any, in lowering the resistance of the arc when it is short.

Arc Lamp.—Prof. Thompson's second Cantor lecture is abstracted briefly in the Lond. "Elec. Rev.," and discussed editorially in the "Elec.," Jan. 25. Among other things he stated that there are such extraordinary variations that it would be impossible to use the crater as a standard of light; the area of the crater is rigidly proportional to the current and therefore the candle power should be directly proportional to the current; the energy developed in a resistance is proportional to the square of the current, but in the arc there is a back E. M. F. and the energy is therefore proportional to the current; it remains to be proved that twice the current gives more than twice the light as is often supposed; he believes it to be absurd to suppose that there can be any difference in the light given out by alternating and continuous current arcs. The editorial argues that for about half the time the light in the alternating arc is comparatively small and that this is surely not the right way of utilizing the energy; if the usual degree of brightness is not maintained the efficiency must be smaller.

Lighting Power of Projectors.—In a continuation of the long serial in "L'Eclairage Elec.," Jan. 12, photographic experiments with the light from the projectors are described, including a number of illustrations showing photographic images of wire gratings.

Mercury Pump.—The "Elek. Anz.," Jan. 24, publishes an illustrated description of the Bock-Kiel pump which is used in the large lamp factories at Lynn and Newark.

Lamp Filaments.—According to the Lond. "Elec.," Jan. 25, a French firm is making lamps with pure graphite filaments; they start at about 1.7 watts per candle and last about 500 hours, during which time they increase to 2.2 watts per candle.

Incandescent Lamps for Explosive Factories.—The Lond. "Elec. Eng.," Jan. 25, abstracts a brief description from a recent lecture by Prof. Lewes, of an incandescent lamp mounted in a glass tube; the description, however, is not very clear.

Carriage Lighting.—The current United States Consular Reports contain a report from France on this subject; the system used in France being briefly described; the lamp is suspended from a sheet of rubber to neutralize the vibration; one accumulator (?) weighing 2 pounds is the allowance for each lamp; an 8-cell storage battery for an ordinary family carriage contained in a box 8 inches long, 4 wide and 7 deep, will light the lamp for 18 hours, which is said to cover a period of 1 to 2 months; the cost of recharging varies from 50c. to $1.00; it is believed that there is a fair prospect that in the course of a few years

the majority of public and private vehicles will thus be lighted; a 2.5-cp lamp will enable one to read in comfort.

Area Lighted by a 16 cp Lamp.—Some figures by Mr. Bain are given in the "Elec. Rev.," Feb. 6; (he does not, however, give the basis on which they are determined, using merely such terms as "ordinary illumination").

Brooklyn Bridge Car Lighting.—The system which is being installed is described and illustrated in the "Elec. Rev." Feb. 6, and "St. Ry. Gaz.," Feb. 2; the current will be supplied by means of the overhead trolley system, the return being through the rails.

Automatic Mercury Pump.—In the "Amer. Jour. of Science" for January, Dr. Pupin describes a new form of pump devised by himself which is claimed to be more rapid and convenient; no cocks are used; an abstract with illustration is published in the "Eng. Mag.," for February.

POWER AND HEAT.

Designing Transmission Plants.—The paper by Mr. Mountain mentioned in the Digest last week is concluded in the Lond. "Elec. Eng.," Jan. 25; he gives comparative estimates in detail of steam and electrical plants for the same purpose. The last part of the paper with illustrations and tables is published in "Ind. and Iron," Jan. 18; it appears to be chiefly for non-electrical engineers.

Electricity in Mining.—A long, illustrated paper by Mr. Lavergne on the mechanical applications is published in the "Rev. Gen. des Sciences," Jan. 15; among other things he illustrates and describes a number of drills and some traction motors.

Direct-Driven Centrifugal Machines.—Several forms made by the General Electric Company, of Berlin, are well illustrated in Lond. "Engineering," Jan. 18.

Electrically Operated Guns.—An illustration of a system installed by Krupp is given in the "Elek. Anz.," Jan. 20.

Operating Ships' Turrets.—The illustrated article on this subject is contained in the "Engineering," Jan. 18 and 25.

Electric Cooking.—In Lond. "Lightning," Jan. 24, Mr. Webber gives the following temperatures: with a jacketed vessel with oil a constant temperature of 400 degrees C. can be obtained and between this and that of a water jacket all stewing processes can be carried out; for roasting-screens before an open fire the best temperatures are 265 degrees F. to begin with and 210 at the end; for baking large bread in an open oven 450 degrees F., for smaller bread 470 degrees F., and for very small pastry 490 degrees F.; for frying in oil, fat or butter a temperature of about 400 degrees F. is obtained, at which there is no risk of spoiling.

Electric Power for Isolated Factories.—An illustrated paper under this heading, by Prof. Anthony, is contained in the "Eng. Mag." for February. The advantages of using electricity are not yet well understood and it is not employed as generally as its advantages warrant; it is not always superior to other methods and each case must therefore be considered by itself; he summarizes the general considerations which will assist in arriving at a solution. He gives several load diagrams made by the Crocker-Wheeler Electric Company giving the indicated hp of the steam engine for every 15 minutes during the day; the average load was 44.1 hp of which 12.8 is useful and the rest friction, 21.3 of which is absorbed by the shafting, thus amounting to 62 5 per cent. of the power delivered by the engine, or 166.4 per cent. of the useful load; if this power were transmitted electrically the power lost in transmission should not be more than half the useful load; assuming that an electric plant to replace the shafting would cost $2,000 it would represent a saving of nearly $700 per year. Another load diagram is given for a large silk manufactory in which the efficiency of transmission is 65 per cent.; it is questioned whether, in this most unfavorable case for electric transmission, the saving affected would not more than pay for the electric installation. He gives a brief description of some typical plants showing the advantages of electrical transmission. The cost will perhaps in most cases exceed that of shafting and pulleys, but in most cases the saving of power more than warrants the additional outlay; he considers it a mistake in any new project not to make a careful estimate of the relative advantages; the advantages must not be expected in all cases to warrant the discarding of existing shafting.

Centrifugal Machines.—Those mentioned above, made by a German firm, and run with polyphase motors, are illustrated in the "Elec. Eng.," Feb. 6.

TRACTION.

Suspended Railway System.—The "Elek. Zeit.," Jan. 17, contains a very favorable report of a municipal commission of Berlin on the Langen system, which it is proposed to use in Berlin. The overhead construction will not interfere with light and air in the houses and is not as unsightly as the usual elevated railways; the absence of a floor reduces the noise to a minimum; the height to which passengers must mount is about 4 feet less; the security against derailing and swinging is quite reliable; a speed of 24 miles an hour can be obtained on level stretches; it is very well adapted for an elevated city railway; it is not possible to transfer the cars on to existing railroad lines but that is not considered an important defect; the cost is relatively small; they recommend constructing a line in Berlin.

The Dietrich-Mueller system is described in the "Elek. Anz.," Jan. 20; in this the car is suspended over the side of the car and not over its centre of gravity, there being an additional track and wheel on the side of the car near the bottom; by this means lateral oscillations are prevented entirely; it is claimed that the supports may be made much fewer than in the Langen system, about 150 ft. apart, as compared with 80 to 100 feet, and that therefore the amount of material required is lessened.

Rapid Transit in Large Cities.—A paper by Mr. Busschere, with particular reference to the London and New York lines, is briefly abstracted in the "Mem. Soc. Ing. Civ." for November; the data seem to be somewhat old.

Underground Railway in Paris.—An illustrated description of the steam road at present under construction, which "it is hoped may be regarded as a forerunner of a metropolitan railway system" is published in Lond. "Engineering," Jan. 25.

Tramway Statistics.—Some statistics in the form of curves from the year 1878 to 1894, compiled for the House of Commons, are reprinted in the Lond. "Elec.," Jan. 25, and discussed editorially; they give the authorized and expended capital, the mileage, the passengers carried, gross receipts, working expenses and net receipts; the mileage and capital in municipal tramways is much less than one-half that of lines built by companies.

Electric Traction.—The third installment of Mr. Dawson's article is contained in the Lond. "Engineering" Jan. 25; it includes some interesting tabulated information concerning electric lines in Europe.

Electric Carriage.—The carriage of Mr. Jeantaud is described and illustrated in "L'Energie Elec.," Jan. 16. The accumulator used is the "Fulmen;" the plates are made of a light lead frame filled with active material and surrounded by an envelope of perforated celluloid; the cells are made of wood lined with celluloid. The carriage contains 21 cells weighing 29.3 pounds each, giving 100 amperes at 40 volts, and capable of discharge at 200 amperes; it will run 1.5 hours, corresponding to 5 ampere-hours per pound at a slow rate, 3.4 at a mean rate and 6.8 at a maximum (there is evidently something wrong with these figures) the speed of the carriage on a level is 12 miles an hour, the total weight is 2,640 lbs., including two passengers, the accumulators weighing 924 lbs., the carriage a little more than this, and the motor 242 lbs.

Power Required in Electric Traction Under Varying Conditions.—In a paper by Mr. Lyman published in the "Sibley Jour. of Eng." for January he gives the results of tests made on electric railways, most of them being from the laboratory records of the Sibley College. He gives the results of a test by Dr. Bedell, at Rochester, in 1891, including some power curves; by Messrs. Wood and Palmer, in Buffalo, 1892; in a large Western city, 1892; at Minneapolis by Profs. Shepardson and Burch (see "Trans. of Am. Inst. of El. Eng.," vol. 9, page 578) and concludes with a description of the tests made in Ithaca, in November, 1894, by Mr. Hewitt and himself. The first of these tests are now somewhat old, but the following results of the last one may be of interest; the results are limited on account of quite a number of mishaps. A baggage car (whether with or without motors is unfortunately not stated, but presumably it had motors) was connected with a dynamometer to a passenger car, the former weighing 8.4 tons and the latter 8 tons; the car was equipped with two 25-hp T.-H. motors of which an illustration is given; he considers the results reliable, although those with the dynamometer had to be discarded. Two round trips were made with this car and trailer from which the following results, all of which are averages, were obtained, the first representing the first trip at about six miles an hour and the second the second trip at about ten miles an hour: Speed in miles per hour 5.93 and 10.18, trolley current in amperes 18.7 and 35, trolley E. M. F. 456 and 456, effective motor counter E. M. F. 188 and 384, applied hp 11.5 and 21.5, applied hp per ton .7 and 1.3, delivered hp 9.4 and 17.85, delivered hp per ton .57 and 1.09, motor efficiency 81.5 and 84.0 per cent., electrical traction in pounds 596 and 657., electrical traction in pounds per ton 36.3 and 40, dynamometer traction in pounds per ton 53.6 for the first trip. During the first run the motors were in series with full field and no rheostat, during the second the two motors were in parallel with full field and no rheostat; it represents normal work with light load; the motor efficiency is the ratio of the effective counter E. M. F. of the motor to the trolley E. M. F. and it was assumed that the load was equally divided between the two motors; the traction per ton varies from 36 to 40 pounds or from 1.8 to 2 per cent. of the weight of the car. Another test was made up a hill 1,793 feet long, the average results of which are as follows: Per cent. grade 8.85, speed in miles per hour 5 45, trolley current in amperes 156, trolley E. M. F. 412., effective motor counter E. M. F. 308., applied hp 87, appled hp per ton 5.3, maximum applied hp per ton 6.8, delivered hp 64.5, delivered hp per ton 3.9, motor efficiency 74.7 per cent. He deduct the actual traction per ton per 1 per cent. of grade for each section and obtains as an average from the developed electrical hp 31.8 pounds and from the traction dynamometer 41.8 pounds per 1 per cent. of grade per ton; these results indicate that the assumption commonly made that the power is equal to "the weight multiplied by per cent. of grade or 20 pounds per ton, is incorrect; the friction of motor gearing which increases rapidly with the traction is probably the cause;" the average current for each motor was 78 amperes and the maximum 98. He adds that the traction of the regular trailer per ton is undoubtedly very much less (from which it seems that the trailer used had motors). In general construction where grades are moderate and where not less than ten cars are on duty at once probably 2.5 indicated hp per ton of car would be a correct estimate for determining the engine power; for not less than twenty cars this would probably be 2.2 indicated hp.

Railway Statistics for the United States.—The "St. Ry. Jour." for February gives a table containing the number of cars and miles of single track in each State at the end of the years 1893 and 1894; the number of cars include both motor and trail cars. The totals for the year 1894 are as follows:—horse: 2,243 miles, 11,507 cars; electric: 9,008 miles, 22,849 cars; cable: 662 miles, 4,673 cars; steam: 614 miles, 2,639 cars; total: 12,527 miles, 41,668 cars. For the end of 1893, horse: 3,574 miles, 16,875 cars; electric: 7,547 miles, 17,128 cars; cable; 657 miles, 47,089 cars; steam: 656 miles, 2,023 cars; total: 12,434 miles, 40,815 cars.

Feeder Cables.—The "St. Ry. Jour." for February contains an article by Mr. Easby on the calculation of feeder cables. He gives a graphical method and shows how the most economical sizes are to be determined.

Chicago Elevated Railway.—The "St. Ry. Jour." for February contains a well illustrated article describing this, the first permanent all elevated electric railway in this country which is now nearly completed; the total length is 18 miles. Regarding this the "West. El.," Feb. 2, quotes Mr. Rae, a large stockholder and director of the Liverpool line, as saying that it is vastly superior to the Liverpool road and he believes it to be the most perfect electric elevated railway in the world.

New York Rapid Transit.—The experts' report is published in the "Elec. Eng.," Feb. 6, and "St. Ry. Jour." for February. They confirm the estimates of Mr. Parsons and suggest modifications and changes to reduce the cost; they recommend electricity as the motive power.

The "Eng. News,' Feb. 7, sums up the recent history of this enterprise.

Germany.—The "St. Ry. Jour." for February abstracts a brief description of some German roads from a recent work published by the General Electric Company of Berlin.

Staten Island.—In the "Elec. Eng.," Feb. 6, Mr. Cochrane discusses the development of the electric railway on Staten Island.

Binghamton.—A description of some length with a number of illustrations is contained in the "St. Ry. Jour." for February.

Conduit in Washington.—A cross-section with a brief description is published in the "Elec. Eng.," Feb. 6.

Conduit Construction in New York.—A cross-section of the street with double tracks is published in the "St. Ry. Jour." for February.

Trolley-Steam Competition in New England.—The "Elec. Eng.," Feb. 6, publishes some recent statements by Mr. Hall, vice-president of the New York, New Haven and Hartford Railroad.

Wheels.—The "St. Ry. Jour." for February contains an article by Mr. Partridge on "Wheel Metal," accompanied by a number of cuts showing the peculiar wear of the wheels; another by Mr. Uebelacker on street railway wheels; another by Mr. Partridge on some figures in regard to car wheel mileage; there are also several communications on wheels.

Motor Repairs.—A paper by Mr. Shepard is contained in the "St. Ry. Jour." for February; he discusses the Short single reduction motors with which he has had extended personal experience; he admits some of their shortcomings, but points out their advantages and believes that they compare favorably with some of the more recent motors on the market; their emergency power he states is remarkable.

Inspection of Rails.—An article on this subject by Mr. Lowenherz is contained in the "Elec. Eng.," Feb. 6.

Fender.—The Yost Fender is described and illustrated in the "Elec. Eng.," Feb. 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Amortization.—Part of a recent paper by Mr. Pruecker is reprinted in the "Elek. Zeit.," Jan. 17. He discusses in detail the subject of amortization of an electric light installation for a period of 40 years, giving curves and data regarding the renewals; he arrives at the approximate figure of 2.3 per cent. of the total capital, or in general beween 2 and 3 per cent. and concludes that the usual 4.5 to 7 and even 9 per cent. do not represent the true amount.

Rules and Regulations.—A discussion of those suggested in Germany (see Digest, Jan. 12) is contained in the "Elek. Zeit.,' Jan. 24.

Electricity in Mines.—A short article by Mr. Chalon, but giving apparently nothing new, is contained in "L'Elec.," Jan. 26; he claims that up to the present time there has not been any explosion due to fire-damp ignited by the electric spark, and he claims that the temperature is not sufficient; it favors chemical combinations, however, and in this respect it becomes dangerous.

Switch Operated from a Distance.—The Wahlstroem system is described and illustrated in the "Elek. Anz.," Jan. 17; it is intended to light or cut out incandescent lamps by means of push buttons placed at any convenient point. The apparatus consists of a magnet having a high resistance winding excited by the push button circuit, the magnet operating a mercury switch; when a push button is pressed the magnet draws up the armature, which at the same time is turned through 90 degrees, and when the push button circuit is broken it drops, closing the lamp connection; when the push button is pressed the second time the same action takes place, but in descending the armature does not drop into the mercury cups; one circuit of all the push buttons is connected directly to the lighting circuit and the other through the magnet to the other pole of the lighting circuit.

The Liesegang system for the same purpose is illustrated and described in the "Elek. Anz.," Jan. 20. There are two magnets opposite each other operated by a battery circuit and acting on a common armature mounted on a spring; when drawn to one side and released its momentum turns a bent lever through 90 degrees which closes the lamp circuit and switches the battery circuit on to the other set of magnets; when this circuit is closed and again opened the oscillating armature turns the lever back to the other position.

Halifax.—An illustrated description of the station in England is given in Lond. "Lightning," Jan. 17.

Accumulators in Central Stations.—A paper by Mr. Markle read at the recent meeting of the Northwestern Electrical Association is reprinted in full in the "West. El.," Feb. 2, and "Elec. Rev.," Feb. 6. He considers that accumulators are eminently fit for fulfilling the three prime functions, namely, as storage reservoirs, for equalization of energy and for transforming, each of which he discusses; a space of 10 yards square will suffice for storing 1,000 kw hours; such accumulators cost less than those used for steam, air or water, the depreciation is less, the life longer and the pressure remains constant; they form the best equalizer, therefore enabling lamps of 2.5 watts per candle to be used, and this represents an economy of current of about 20 per cent.; German statistics show that by far the greatest fuel economy and net earnings is shown by accumulator stations; one firm alone has installed 100 central stations and 3,000 isolated plants. He states that the loss and voltage should not be estimated singly, but should be "computed on the total electrical energy generated by the station, and the total values thus fairly arrived at. Average practice shows that where batteries are working at an efficiency of 75 per cent. the ratio of battery loss to total net output is from 10 to 14 per cent. and at 85 per cent. battery efficiency, 6 to 9 per cent." The depreciation and repairs he states are about the same as on a steam plant; he cites the railway plant in Zurich (described in the Digest, July 28); he states that it is erroneously believed that an accumulator plant is expensive, and gives an estimate for a 500-hp plant which by the direct system costs $47,000 and by the storage system $46,000, in the latter the steam and electric plant having half the hp, the price of the accumulators being $22,500.

Municipal Plants.—A brief description of the question why they succeed and why they fail is discussed briefly by Mr. Winchester in the "Elec. Eng.," Feb. 6. He is connected with the South Norwalk municipal station; he advocates municipal ownership only under the most favorable conditions, which are seldom met with; their increase he thinks is largely due to schemers who erect a cheaply constructed plant which is unsatisfactory and it is then as a last resort that the people consider a municipal plant; the great enemies to the latter are politics and partisanship, and success can never be expected until such plants are constructed on strictly business principles; when such a time arrives there is no reason why cities cannot operate such plants with more economy, as the profits would go back to the taxpayers.

Mexico.—A brief description of a central station at Aguas Calientes is given by Mr. Guy in the "Elec. Eng.," Feb. 6.

WIRES, WIRING AND CONDUITS.

Explosions Due to Underground Mains.—Lond. "Elec. Eng.," Jan. 25, publishes a reply from the managers of 21 stations in England to a number of questions regarding this subject; the answers, which are very brief, appear to contain nothing new but may be of some interest as showing the systems of mains and conduits used and their freedom from trouble; one writer believes that freedom from trouble is due to the use of concentric cables in connection with sealed fuse boxes; another suggests preventing explosions by charging the gas company with the expenses and damages.

Leads and Networks of Conductors.—A paper by Mr. Teichmuellel is reprinted in full in the "Elek. Zeit.," Jan. 3; it is in part somewhat elementary in character. In reviewing the history he credits Ronalds with having laid the first underground lines in the year 1816; he describes at some length the "German" system of calculating the cross-sections in a network of conductors, claiming that it is after all the only proper way of attacking the problem; after making a number of such calculations one is then better able to make proper estimations; there are four methods, each of which he discusses.

Laws Concerning Electric Lines.—The French laws concerning lines other than those for telegraphic and telephonic purposes are published in "L'Eclairage Elec.," Jan. 12.

Interior Conduits and Interior Wiring.—A paper by Mr. Burton read at the recent meeting of the Northwestern Electrical Association is reprinted in the "West. El.," Feb. 2; he enumerates the advantages of this system; its cost is about 20 per cent. greater than that of the ordinary system.

ELECTRO-PHYSICS AND MAGNETISM.

What Is Electricity.—Prof. Fleming's views as stated in a recent Royal Institution lecture are given in "Ind. and Iron," Jan. 18. Science is beginning to recognize that electricity is probably a wave disturbance of the ether, analogous of that called light; with light the waves vibrate at the rate of 45 millions per second with an amplitude of oscillation of 37,000th of an inch; electricity is a wave motion with waves yards in length and also of great rapidity.

Electricity.—A long paper by Mr. Feldmann on the latest views on the nature of electricity is reprinted in the "Elec. Echo" for January; it appears to consist of a summary of the present views on the subject.

Electromagnetic Theory.—In a communication to the Lond. "Elec.," Jan. 25, by Prof. Perry, he explains some points in Mr. Heaviside's article with the intention of making it clearer to the beginner.

Electromagnetic Oscillations.—Some recent researches by Prof. Minchin are discussed briefly in the Lond. "Elec. Rev.," Jan. 25.

Propagation of Electric and Magnetic Perturbations.—The serial by Mr. Blondin (see Digest, Oct. 6 and 27,) is continued in "L'Eclairage Elec.," Jan. 12; he discusses the measurement of the velocity.

Thermoelectric Properties of Platinoid and Manganin.—A paper by Mr. Peirce from the "Am. Jour. of Sc.," Vol. 48, Oct., 1894, is reprinted in the Lond. "Elec. Rev.," Jan. 25; he gives the results of a series of measurements.

Phosphorescence.—The Lond. "Elec.," Jan. 25, states that Prof. Dewar recently corroborated the theory of Prof. Stokes, in which he regarded phosphorescent bodies as optical transformers that is, as an apparatus for converting the short non-luminous rays into light; Prof. Dewar found that at —200 degrees C. numerous substances, including photographic plates, phosphoresced.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity Direct from Coal.—The Lond. "Elec. Rev.," Jan. 25, comments on the recent papers on this subject, all of which have been noticed in the Digest. Regarding Mr. Reed's criticism (see THE ELECTRICAL WORLD, Dec. 22, p. 637) in which he claims that the E. M. F. is derived from the copper, it is claimed that this was foreseen by Dr. Borcher, and that in a special experiment he found that when carbonic oxide was dissolved in the electrolyte in contact with the copper, then instead of the copper being dissolved there was a slight deposition of copper on the copper electrode and, therefore, the chemical energy cannot be derived from the consumption of the copper. The practical utility of Dr. Borcher's invention has yet to be proved; it has been seriously damaged by hostile critics. "It is not to be expected that a discovery which has been received with enthusiasm in Germany by such authorities as Prof. Ostwald should turn out to be merely a mare's nest."

Gas Batteries.—The Lond. "Elec. Rev.," Jan. 25, abstracts briefly the recent paper of Mr. Smale, giving but very little more than was contained in the Digest, Feb. 2. The original appeared in the "Zeit. f. Phys. Chem.," Vol. 14, page 577. The following are also recommended: "The Potential of Hydrogen and some Metals," by Mr. Neumann, "Zeit. f. Phys. Chem.," Vol. 14, page 193, and the "Voltaic Chain," by Mr. Goodwin in the same, Vol. 13, page 577.

Process for Reducing Aluminium.—The process of Mr. Gooch (New Haven, Conn.) is described and illustrated in "Ind. and Iron," Jan. 18; it consists in general of passing a current through a fused bath containing a halogen compound of aluminium and supplying to the bath a vapor of water; the best compounds are chloride and fluoride of aluminium.

Fulmen Accumulator.—See description under Electric Carriage.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Primary Batteries.—In an illustrated paper of considerable length by Mr. Strecker published in the "Elek. Zeit.," Jan. 3, he points out that it is not rational to test an open circuit battery by discharging it at a continuous current nor by short circuiting it; to test a cell by connecting it with a bell is rational only when it is to be used for such continued service; to test cells by discharging them through a small external resistance and measuring the current and the voltage, is subject to errors and is not rational; a general method of testing cannot be given, as it should be modified according to the use for which the cell is intended. He then describes at considerable length a method which he recommends; for closed circuit work all that is necessary is to discharge it continuously at the required rate; for open circuit work he describes and illustrates an apparatus which he has used for some time in which the circuit of the cell is closed through a given resistance periodically by a clock; for a telepone cell, for instance, it is closed every 15 minutes for 3 minutes though a resistance of 5 ohms; the hands of a clock were removed and discs with pins substituted; as often as is desired the E. M. F., the internal resistance, and the current are measured; for measuring the voltage the galvanometer should have a resistance of at least 20 ohms per volt; for measuring the internal resistance he describes and illustrates the modified Wheatstone bridge method, in which an alternating current from an induction coil is used as the source of energy, a telephone replaces the galvanometer, the battery forms one arm of the bridge and the two other arms are formed by a slide wire resistance. By this method of testing a good cell will last from a few months to a half a year; with the apparatus described he tested 40 cells at a time; curves are given showing the results of some of the measurements.

Testing and Inspection of Electric Light Cables.—The article in the Lond. "Elec. Rev." is concluded in the issue of Jan. 25; for the first part see Digest, Feb. 2. It is claimed that a maker's guarantee of 100 per cent. conductivity is worthless, as neither the weight nor the diameter of the copper wire in the finished cable can be determined; the specifications should call for a resistance equivalent to one of 100 per cent. He recommends a convenient instrument made by Elliot for measuring conductivity; he calls attention to the great importance of the electrostatic capacity when the cables are to be used for alternating current; care should be taken not to use only one or two cells in determining the capacity as the earth plate may have an E. M. F. of its own.

High Tension Cable Tests.—In a communication to the Lond. "Elec. Eng.," Jan. 25, the importance of the use of high voltage continuous current dynamos for testing continuous current cables is pointed out, and it is stated that dynamos up to 5,000 and even 10,000 volts have been constructed.

Measuring Resistances.—The formulas and a diagram showing the connections of the system devised by Dr. Pasqualini, described in the Digest, Jan. 12, is published in the "Rev. Gen. des. Sciences," Jan. 15.

In a short Academy paper by Mr. Colson he calls attention to important errors in measuring resistances by the bridge method with an alternating current and a telephone, and points out the precautions which must be taken.

Resistance Wire.—A table of the electric qualities of some resistance wires made by a German firm is published in the Lond. "Elec. Eng.," Jan. 25; the patent wire called Ia. Ia. hard has a specific resistance of 50.2 microhms per cb cm and a temperature constant of —0.000011 per degree C.; for a new quality called "superior" these figures are 86 and + 0.00072.

Conductivity of Organic Substances.—The Lond. "Elec. Rev.," Jan. 25, gives the results of recent investigations by Mr. Bartoli. (See also Digest, Dec. 1.)

TELEGRAPHY, TELEPHONY AND SIGNALS.

Review of the Past Year.—The "Jour. Teleg.," Jan. 25, contains an interesting review of telegraphy and telephony during the past year. After reviewing the history for the past 25 years as recorded in that journal, a number of interesting statistics for the past year are given. The total number of cables laid in 1894 amounts to 6,832 miles; a table giving the mileage of the telegraph and telephone cables of the world is given; among the totals are the following: 1,240,000 miles of telegraph lines amounting to 3,000,253 miles of wire; for telephony these figures are 151,000 miles of lines, amounting to 846,000 miles of wire. Another table gives the number of messages, showing an increase of 3.05 per cent. over the messages sent in the countries themselves and an increase of 10.91 per cent. in the number of international messages; the increase in incomes was 6.04 per cent. Another table, though not complete, gives data regarding the telephone messages during the last year, the average of which is 6.4 messages per subscriber per day, the figure for United States being 7.3, which is exceeded only by Austria, in which it is 12.4.

Telegraphic Statistics for 1893.—The "Elek. Zeit.," Jan. 17, reprints a large table from the "Jour. Teleg.," which is incomplete, and adds some further data.

Paying for Telephone Service.—The "Elek. Zeit.," Jan. 24, contains a long illustrated paper by Mr. v. Barth describing his system, devised to solve the problem of charging for the number and lengths of the conversations; in an editorial the system is discussed favorably with the addition of some criticisms; it is used in the city of Stockerau near Vienna, where it was started in December.

Origin and Development of the Telephone Switchboard.—An Institution paper by Mr. Kingsbury, of some length, is reprinted in full in the Lond. "Elec. Eng.," Jan. 25.

Muirhead vs. Commercial Cable Co.—The Lond. "Elec. Rev.," Jan. 25, contains a communication by Mr. Dearlove, upholding the recent views expressed in "Engineering." (See Digest, Jan. 19.)

Phonopore.—A well illustrated description by Mr. Spagnoletti is published in Lond. "Lightning," Jan. 24.

Synchronizing Apparatus.—The Blut system for synchronizing printing telegraph apparatus with clockwork motors is illustrated and described in the "Elek. Anz.," Jan. 13.

Clocks.—The system of Mr. Kesel for operating clocks by means of alternating currents is described and illustrated in the "Elec. Echo," Jan. 12.

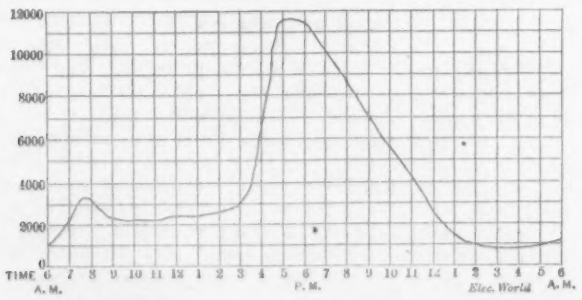
Dynamos for Fire Alarm Telegraphy.—The "Eng. Mag." for February abstracts from "Fire and Water," Nov. 17, an article by Mr. Flanders; he uses a motor-generator driven from central station mains; the average current for each circuit is 0.04 ampere at 50 volts; it replaces 350 gravity cells and will suffice for double the plant; he considers it greatly superior in every respect to any form of battery; it has been definitely adopted in a station which he is equipping.

Microphone.—An article of a popular nature by Mr. Perry is published in "Electricity," Feb. 6.

MISCELLANEOUS.

Mr. Crompton's Presidential Address to the Inst. Elec. Eng.—The Lond. "Elec. Eng." reprints the whole address and the "Elec. Rev." and "Elec." give the first part; the latter journal also discusses it in the leading editorial. He deals with electrical engineering chiefly from the mechanical engineer's point of view, believing as he does that its great development dates from the time when the mechanical engineer first undertook the design and construction of dynamo-electric machinery; he forms a mental picture by considering electricity as "an infinitely flexible connecting rod by which we transmit energy and reproduce it at a distance in any desired form." He discusses the chief materials used, iron, copper and insulating materials; the improvements in the first two have been very marked and have probably reached a finality, but little advance has been made in insulating materials, which latter subject he discusses. The conditions under which electrical engineers work their engines and boilers differ so widely from those for driving factories that the experience of mechanical engineers is of little

or no value, in fact is misleading in many respects; it was the exigencies of electrical engineering that led the late Mr. Willans to carry out his extensive series of experiments. In speaking of the load factor he calls attention to the differences between the summer and the winter diagrams; this will always exist if the energy is used only for lighting, the remedy being to encourage its use for motive power, heating and cooking and he believes the public ought to be educated to the advantages of using electricity for heating; electrical cooking is certain to obtain popularity in hot climates or in summer. Regarding the use for motive power he calls attention to the large motor load in American stations while that in England is insignificant; he discusses the use of motors and shows that in many small workshops it would be an advantage to use such motors. He believes that electrical energy could be applied in considerable quantities in residential districts for the production of artificial cold by means of motors driving air compressors and then expanding the cooled compressed air; he believes that the advantages of such cold storage are so obvious that it is unnecessary to further insist upon them. He discusses briefly the advantages of electrical transmission to machine tools, quoting Prof. Kennedy's recent figures in favor of belt transmission, but pointing out that the great advantage of the electrical system is when the machine tools are standing idle during a comparatively large time and he adds that these cases are far more numerous than Prof. Kennedy's figures lead one to suppose; he corrects these figures accordingly and obtains others very much more favorable for electrical transmission; of all methods of transmission that exist none involve so little waste of power during the periods of idleness as electrical transmission. He discusses the subject of variable gearing, calling it "speed torque ratio gear" and he thinks the first real step which promises to revolutionize our ideas on this matter has been the solution of the problem in the electrical part of the plant; as an illustration of one solution he describes the well known system of H. Ward Leonard, which he discusses very favorably; he believes that there are many similar methods by which this can be worked out electrically with great simplicity; he describes how it may be applied to long distance transmission with high tension alternating currents transformed down to say 500 volts and then used to work an alternating current synchronizing motor driving the generator which in turn drives the main motor. Regarding the electrical instruments he protests against the very impossible degree of accuracy which is often claimed and points out the advantages of an easy method of checking instruments, which he does by a balance method, namely, by means of the potentiometer and the standard cell; in this instrument there are no moving parts and the only calibrated portion, the slide wire, can be subjected to extremely rough treatment without altering the accuracy of it (but will the standard cell stand rough treament?); he speaks very highly of the recent progress in the platinum thermometer, which he says becomes a very valuable instrument in connection with the potentiometer; he believes that this method of measuring temperature is not generally known and appreciated. He approves of the zero methods and states that there are two, one in which there is a simultaneous balancing of two forces and in the other a balance of each of two in turn against a third, the latter being the one which he prefers, as it avoids great possibilities of error; for accurate measurements of large currents, he uses sheets of manganin. Regarding electrical storage he says that the progress in its development has been quite as marked and quite as satisfactory as that of the dynamo or the alternator; he alludes to the improvement in detail and in manufacture rather than in alleged new inventions; he believes that there exists a great and unwarranted prejudice against the storage battery; it demands as high qualities for its patient investigation as does any other branch of electrical engineering; those who cannot see the importance of improving electrical storage show that they have a very incomplete grasp of the requirements; the difference between the charging and the discharging E. M. Fs. is satisfactorily made up by the various booster systems; many of the troubles were due to a want of knowledge of the necessity of the extreme purity in the materials used, impurities being the cause of self-discharge of the negative plates and account for most of the early breakdowns which seemed so mysterious; copper and arsenic have a very prejudicial effect. He spoke at some length against placing too much confidence in very young engineers whose engineering life and experience has been very short; he believes that soon a reaction will set in which will greatly damage the interests



of our profession, due to this cause. In conclusion he refers to some Institution matters and shows a very interesting load curve of the combined output of all of the London central stations, which is shown in the adjoined figure; it was taken simultaneously for this purpose on the 20th December, ending at 6 a. m., and he believes that it is one of the largest that has ever been drawn; the maximum load was at 5.30 p. m. and was equal to 11,600 kw, the minimum load was at 4 a. m. equal to 800 kw, the load factor is 33 per cent.

Mr. Crompton's address is discussed editorially in the Lond. "Elec. Rev.," Jan. 25, which expresses agreement regarding the dangers arising from the growing number of young and inexperienced engineers; belief is expressed that the only means of overcoming the load factor difficulty is by the use of adequate storage; heating, cooking, motors, etc., will not improve it as they overlap with the lighting load in winter.

Calcic Carbide.—A recent lecture by Prof. Lewes, on illuminating hydocarbons, is reprinted in full in Lond. "Ind. and Iron," Jan. 25, and abstracted briefly in the Lond. "Elec. Eng.," Jan. 25; it is devoted almost entirely to the gas acetylene $C_2 H_2$ and more particularly to its production from calcic carbide $Ca H_2$ produced in the electrical furnace (see Digest, Jan. 12 and 26); it contains much interesting information. He states that it is hardly possible to foresee the results which will be ultimately produced by a cheap and easy method of preparing this most useful gas; he gives its properties and shows how it may readily be converted into benzol, aniline and other useful products; he considers that the field opened up by the commercial production of calcic carbide is wonderfully and intensely interesting. Calcic carbide contains 40 parts by weight of calcium and 24 of carbon and on the addition of water the oxygen combines with the carbon to form slaked lime while the hydrogen unites with the carbon to form acetylene; calcic carbide is a dark gray substance having a specific gravity of 2.262 and when pure a pound will yield 5.3 cb. ft. of acetylene; its surface is slightly acted upon by atmospheric moisture unless it is protected, and in practice it therefore does not yield more than 5 cb. ft., but in lumps it does not degenerate very fast; for commercial purposes it is cast into rods 12 inches long and 1.25 in diameter weighing 1 pound and giving 5 cb. ft. of gas 98 per cent. pure; the gas has such a penetrating odor, resembling that of garlic, that it would be practically impossible to go into a room which contained any dangerous quantity of the gas; when liquefied and then sprayed into the air it freezes into a snow-like solid which burns; he has a grave mistrust of the methods used in this country in which the gas is mixed with an equal volume of air before being burned, as the danger of making an explosive mixture must be very great and furthermore the diluting action of the nitrogen reduces the illuminating value from 240 to 130 candles; it may easily be stored by liquefying and it is then of great value for portable lamps, floating buoys, illuminating country houses, etc.; the gas when burned in a suitable jet at the rate of half a cubic foot per hour will give a light of over 20 candles for about 10 hours from one stick weighing 1 pound; it is well adapted for railway lighting; London gas has an illuminating power of 16 candles (presumably per 5 cb. ft. per hour) whilst acetylene gives 240 candles, or for the same light-giving value it will be equivalent to London gas at less than 12c. per 1,000 cb. ft; 100 cb. ft. of London gas yields 50 cb. ft. of carbon dioxide and 140 of water vapor, whilst the same quantity of acetylene gas yields 200 ft. of the former and 100 ft. of the latter, but for equal illumination the amount of the carbon dioxide and water produced is enormously smaller; he gives a table for 48 candles showing that the amount of acetylene consumed is 1. (presumably 1 cb. ft. per hour), the amount of carbon dioxide produced is 2. corresponding to the amount exhaled by 3.6 adults; by way of comparison number 5 flat flames with ordinary gas consume 22.9 cb. ft. generate 12.1 of carbon dioxide, corresponding to 20.1 adults; a paraffin lamp corresponds to 22.5 adults, while 48 sperm candles would correspond to 32.7 adults. The flame is a distinctly cool flame, the temperature being about 1,000 degrees C, while that of the ordinary gas flame is 1,360 degrees C, or for the same illumination the heat effect would not be much greater than that of the ordinary electric incandescent lamp. It is stated by another writer to have great diffusive power combined with high illuminating power. (If this gas should turn out to be a serious rival to the electric light, might it not be profitable to utilize the machinery at central stations during the day time for the production of calcic carbide, thus obtaining a very profitable and adjustable day load?)

The Lond "Elec," Jan. 25, reprints the paper abstracted in the Digest, Jan. 26, and comments on it unfavorably. It states that the attempt to calculate the cost of the process is not a satisfactory one, as no charge is made for capital depreciation, etc.; it merely proves that 2,000 pounds of acetylene cannot be generated by this process for $37; Prof. Lewes stated that a 5-ft. burner consuming pure acetylene can develop 240 cp; it is claimed that this is balanced by the highly explosive and poisonous nature of this gas, also by the fact that it would never do to distribute it commercially in the pure state; it considers the development as being little past the laboratory stage.

Price of Ozone.—In a paper by Dr. Froelich in the Lond. "Elec. Rev.," Jan. 18, he gives the quantities of ozone required for various purposes. Twenty grams are produced by 1 hp-hour costing in Berlin about 4c.; this will bleach 110 pounds of linen as well as grass bleaching during 3 days; it will bleach and refine 88 pounds of potato starch, in the presence of some chlorine, to such a degree that the color becomes a beautiful white and all the bad odor and taste are removed; if this is roasted and ozonization continued, a product resembling gum arabic is obtained; 20 grains of ozone being sufficient for 66 pounds of this product; the same quantity will ozonize a room containing 8,000 cm in such a way that healthy persons can just endure it; the quantity has the same oxidizing effects as 1.1 pound of the ordinary solution of peroxide of hy-

drogen and it can be made at half the cost. The ozone is measured by the absorption in a solution of iodide of potassium and measuring the precipitated iodine.

Graphite in Iron.—In an Academy note by Mr. Moisan published in "L'Elec," Jan. 26, he gives certain conclusions regarding the formation of graphite in iron at various temperatures and pressures.

Educational.—The Lond. "Elec.," Jan. 18, contains a communication of some length by Prof. Perry on the subject of "labor saving apparatus" (see Digest, Feb. 2). The article does not admit of being abstracted; it is in defence of Prof. Ayrton's method, which he says has become very general all over the world; he calls attention to the fact that the students have a very extensive course of laboratory instruction in which corrections of all sorts of errors and the calibration of instruments occur over and over again; "his critics seem to think that in measuring the mechanical equivalent of heat his students should not go straight at the actual problem but should take up every problem that any investigator found in his way. Is it a lack or a superabundance of humor?" "Too many teachers believe that as the great chemists of a hundred years ago had only tumblers and water-buckets for apparatus, it is making the road to the chemists' heaven too irreligiously easy for him to give the beautiful apparatus now at his command;" he is convinced that there is no teaching power whatever in mere lectures on physics and mechanics and that individual laboratory instruction must be given, without it, students may pass examinations, but the teacher is causing a deterioration of their mental powers all the time. He gives his idea of the work in a mechanical laboratory and states that the apparatus should be as small as possible, for if it is complicated and requires all sorts of corrections it only causes confusion in the mind of the beginner; this system was begun by Prof. Ayrton and himself in 1881 and is now in active use in most institutions all over the world; his experience has confirmed his opinion that this is the only proper way, "on any other system the mental fatigue of the demonstrators must be appalling, if the whole thing is not a farce;" those doing original work, design and make the apparatus themselves; the ingenious instructor will find enough elasticity in the system for what is practically perfect freedom.

The subject of "Labor-Saving Apparatus" is discussed by Mr. Boys in a communication to the Lond. "Elec.," Jan. 25. (See also Digest, Jan. 26, Feb. 2.) He objects to the title of the original paper (see Digest, Jan. 12) as the student does not determine the mechanical equivalent of heat, nor does he determine anything except that "the various figures that are given to him, when multiplied and divided in the manner he is told to employ will work out and produce an answer which is right;" the student does not find any of the important data and depends only on what he is told; a true determination is one which ultimately brings the experimenter to length, mass and time alone; he believes it would have been better to have used mechanical means. He states that he has nothing to do with teaching technical students; he believes in the use of primitive and extemporized apparatus as it will teach the student more and will prevent him "developing into the helpless creature that a pure system of science-made-easy is apt to produce." "This sort of training will produce not the self-reliant engineer but an eminently useful drudge. It is not by such methods that Hopkinsons and Kennedys are made to exist." He protests against the title of the paper in order to prevent less enlightened teachers from taking this paper as a model of educational propriety.

Birds Killed by Lightning.—The question of whether birds on the wing are ever killed by lightning is discussed briefly by Mr. Varley in the Lond. "Elec. Rev.," Jan. 18. He believes that it may occasionally happen but simply by their being accidently in the line of the path of discharge or in very close proximity to it; he believes that it is possible that a bird might be killed by the concussion of the expanded air close to the line of discharge.

Measuring Wires.—A convenient form of apparatus for measuring the length of wire as it is wound on magnets is illustrated and described in the "Elek. Anz.," Jan. 13.

Biographical.—The Lond. "Elec.," Jan. 25, contains a biographical sketch of Mr. Crompton, accompanied by a full-paged steel engraving.

Electrical Discovery.—A new fortnightly publication with this name has been started by a firm of patent agents in London.

Magnetic Governor.—The Melott Engine Governor is described and illustrated in the "Elec. Eng.," Feb. 6. The action of the balls in a fly-wheel governor is supplemented by magnetic attraction produced by a coil on a core, the main current passing through the coils; when an extra load is thrown on the dynamo it will cause the governor to regulate before the centrifugal force has a chance to act.

Aluminium.—According to the "Eng. and Min. Jour.," Feb. 2, the French Government has given a single order for 92,400 pounds of aluminium to be used for the construction of steam launches for the navy; the only company in Europe which can fill this order without great delay is the one at Neuhausen.; this is probably the largest single order ever given.

Shock from Static Discharge.—In the "Elec. Eng.," Feb. 6, Mr. Henry relates a case in which a man was severely shocked from a circuit of 50 volts and he believes it was due to a static discharge from the core of the transformer; he recommends the European practice of grounding the transformer cores.

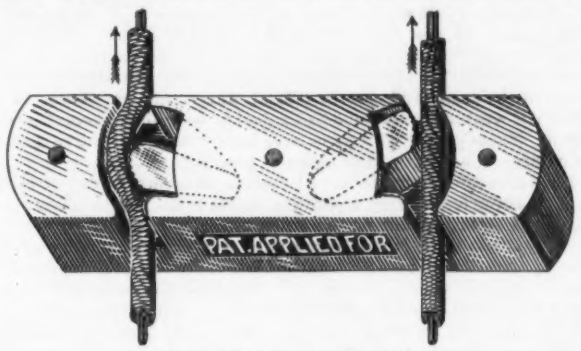
Treatment after Electrical Shock.—The "Elec. Rev.," Feb. 6 reprints the rules prepared for the Ministry of Public Works in Paris, mentioned in the Digest, Feb. 2.

Rheumatism.—In a short communication to the "Elec. Rev.," Feb. 6, Dr. Hornsby discusses the application of electricity and concludes that as high frequency alternating currents act as stimulants of nutrition, and as rheumatism is primarily due to bad nutrition, therefore electricity intelligently applied would seem to be indicated.

Review of the Past Year.—The "Journal of the Franklin Institute" for February contains an abstract from the Secretary's report on the annual review of science and industry, a considerable portion of which is devoted to electrical subjects.

A New Self-Locking Cleat.

We illustrate herewith a new self-locking cleat, shortly to be put on the market by Creager & Connard Company, Marseilles, Ill., which is claimed to be both positive and reliable in its operation. The arrows in the cut show the direction in which the line is being run. It is claimed that it is only necessary to draw the wire as taut as possible or desirable and release it, when the serrated face of the dog will cramp the wire into the curved wall and hold it taut. It is further claimed that the use of



SELF-LOCKING CLEAT.

this cleat will enable one man to do the work usually done by two, as it does not require one to pull the wire while another fastens it, the mode of precedure being that the wireman first puts up all his cleats, reversing the first so as to hold the starting end, and then simply pulls the wire taut from cleat to cleat, or at alternate cleats, where it is held by the dogs. The cleats are, of course, made of porcelain to conform to underwriters' requirements.

A Municipal Lighting Plant in Trouble.

The town of North Attleboro, Mass., some time ago appropriated $50,000 to buy the local electric lighting plant and extend it. The Municipal Light Act, passed by the Massachusetts Legislature in 1891, provides that when a town and a private company cannot agree on the price to be paid for the plant of the latter, each party shall file, within sixty days after the final vote of the town, a petition with the Supreme Court for the appointment of commissioners to settle the question. In this case neither side did so. The town's committee went ahead and put in the plant and paid for it, and it has been in operation nearly a year. The old company has now brought action against the town in the amount of $20,000 and applied for a writ of injunction to prevent the town from further running their plant. It is reported that some of the ablest legal talent in the State contend that the town has no legal right to be in the electric lighting business.

Water Power Development and Electric Transmission for Atlanta, Ga.

For several months past negotiations have been in progress looking to the development of large water powers on the Chattahoochee River near the city of Atlanta, Ga.

The matter has chiefly been carried forward by Mr. J. H. Vail, of New York City, and has resulted in the organization of the Atlanta Electric Power Company, which will control an aggregate of about 30,000 hp divided between two powers, one-half of the amount within nine miles of the city of Atlanta, and the remaining amount of 15,000 hp within thirteen miles from the same city. Both powers are derived from the rapids of the Chattahoochee River. The first dam and power house will be located near Vinings Station on the Western and Atlantic Railway. The surveys have been completed and the plans and specifications for the construction of the dam and power house and system of transmission are finished.

The principal parties interested are: James Swan, President of the Atlanta National Bank, Atlanta, Ga.; A. E. Thornton, Vice-President Atlanta National Bank, Atlanta, Ga.; H. R. Garden, lawyer, of New York City; J. H. Vail, President of Electrical and Mechanical Engineering Company, of New York City, together with other prominent business men in the city of Atlanta. The entire construction has been placed in the hands of the Electrical and Mechanical Engineering Company, 39 Cortlandt street, New York City. It is stated that ground will be broken at an early date and the work pushed forward rapidly.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 9, 1895.

GENERAL ELECTRIC alone of the electric stocks has betrayed any distinct signs of being alive this week. What with the approach of the annual meeting and the closing of the company's books on Jan. 31 last, speculation is rife as to what the year's operations have resulted in, and considerable interest is evidenced regarding the stock's future. Of late a distinct bearish tendency has developed in the stock, and certain official statements have been twisted into admissions of weakness that have had a deal to do with the recent sagginess of quotations. These perverted reports have been brought to the ears of the company's managers, and they have hastened to counteract the baneful influence created by these misconstructions of former statements by definitely declaring the General Electric Company's position. There is nothing to warrant the statement so much circulated during the last two weeks that it has no net earnings beyond its interest charges, and that bonds retired were purchased from proceeds of liquidated accounts. Nothing has been officially said to justify any such inference. The forthcoming report will show that the company has increased its plant and machinery, and that for the year ending Jan. 31, 1895, it earned not only interest on its bonds, but the full dividend on the preferred stock issue, and something on the common stock. It has been freely charged that all this apparent increase of profits will be wiped out by the depreciation in the value of the General Electric Company's franchise and patents which in the last annual report was figured at $8 159,264. In this connection it might be well to quote what a well posted electrical authority has to say in the *Wall Street Journal*. He remarks: "While it is true that a number of important patent issues have been decided against General Electric, notably the 'Feeder and Main,' nevertheless the company still controls a sufficient number to enable it to manufacture every line of goods. These various patents will expire from year to year (the incandescent lamp will be among the first), but this will not necessarily interfere with the business of the company. General Electric no longer controls business through a monopoly; but it can manufacture the best at the lowest price. This is the secret of the company's strength to-day. If it cannot in the future control certain patents now owned by it, it is certain that no other concern can. This means open competition, for which the General Electric Company is as fully equipped as any of its competitors." To-day the company is on a bed-rock basis. The stock has discounted long ago all the disastrous features revealed in the report of 1894, and, if it was worth 30 a year ago, it is certainly worth more now. If it had not been worth 30 a year ago, it would surely have gone lower, in view of the demoralized aspect of affairs at that time. Prospects now are bright; the electric industry is a rapidly growing one, and General Electric, with its prestige, must secure its proper share of the increasing business.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	100	100½
" " " Brooklyn	100	108	110½
" " " Boston	100	123	126
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
General Electric	100	28¼	28⅝
General Electric, pref	100	61	67
Westinghouse Consolidated, com	50	32	32¼
" " pref	50	49	50

BONDS.

Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	90½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	191	192
American District Telegraph	100	45	49
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	135	140
Erie Telephone	100	48	50
Gold & Stock Telegraph	100	104	110
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97½	99
Postal Telegraph-Cable	100	54	58
Western Union Telegraph	100	87⅛	88

WESTINGHOUSE ELECTRIC issues have fluctuated very little this week. What change was noted has been more in accord with the general speculative feeling than by reason of anything in the affairs of the company. There are good grounds, however, for basing hopes of increased profits and accordingly higher stock market quotations. The company, it is stated, is getting the bulk of the street railway business. By reason of certain economies introduced in manufacture, the Westinghouse Company is now in a position to undersell its competitors. It is offering, so it is reported, street car equipments $100 cheaper than its leading rivals. Working in connection with the Westinghouse Air Brake Company, it is forcing prices down by now selling for $150 what it costs other makers $225 to manufacture. Then again it may be that its appeal from the lower court's decision in the suits for alleged infringement of the Sawyer-Man electric light patents will be decided in the Westinghouse Company's favor. In such an event, other concerns will have to pay large royalties to the Westinghouse Company. At any rate, stockholders have cause to be elated by the company's prospects, and there is likely to be an early and substantial market appreciation of these facts. Pittsburgh still reports a lively demand for the scrip at 97, with none coming on the market.

EDISON ELECTRIC ILLUMINATING, of New York, holds very strong. The company enjoyed an enormous increase in business in 1894, and there is every reason to believe that the electric lighting business will make equally rapid strides forward during 1895. As is aptly pointed out, the industry has been hampered in the past, owing to the high price demanded for apparatus, but manufacturers and operators are now contenting themselves with moderate profits, and their business is sure to be largely benefited thereby.

EDISON ELECTRIC ILLUMINATING, of Boston, justifies equally nice things being said of it. The stockholders have just testified to their appreciation of last year's record by re-electing the company's directors and officers. The annual report for 1894, just published, shows that gross earnings were $628,406, a gain of $34 318 over the figures for 1893, and the net income, by reason of reduced expenses, was $307,164, a gain of $54,913 over the profits of the preceding year. There were 100,047 incandescent lamps connected, a gain of 13,585 over 1893, and 853 arc lamps, a gain of 148. A sum sufficient to meet the cost of new lamps, services and meters, as well as possible depreciation of storage batteries, underground and other construction, has been taken from the 1894 net earnings, and during 1895 these deductions will be made monthly.

ERIE TELEPHONE is very quiet. The company makes this report for the quarter ending Dec. 31: Gross, $270,337; increase, $13,011; dividends received, $61,587; increase, $3,587; dividends paid, $48,000; surplus to Erie Company, $13,587.

AMERICAN BELL TELEPHONE remains practically unchanged. Not much interest is taken, apparently, in the stock's doings. It comes from good authority that there are to be three syndicates to bid for the 3,300 shares of Bell Telephone Comany stock soon to be sold at auction; this is in addition to a syndicate made up of large Bell Telephone stockholders who will see for self-protection that the price realized comes up at least to market quotations.

ELECTRIC TRACTION stocks have again remained stationary. There is very little at present doing in them. In view of the enormous interest these issues represent, it is strange that so little attention is devoted to their doings. As illustrating the scope of these interests it is to the point to quote some offical figures recently made public. The Massachusetts State Railroad Commission reports that for the year ended Sept. 30, 1894, street railways increased to 928,843 miles; of this 824,971 miles were operated by electricity. Electrically equipped roads increased in one year 113,889 miles. The New York State Railroad Commission reports that since 1883 the increase in the capital stock of electric and horse roads has been $34,930,000, and most of this was for electric roads.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	115	125
Brooklyn Traction, com	9⅜	11⅛
" " pref	54	58
Long Island Traction	9	9⅛
Rochester St. Ry	36	38
Columbus St. Ry	48	50
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	15	16
New Orleans Traction pref	56½	59½
Worcester Traction com	12½	14
" " pref	78½	80
Metropolitan Traction, Philadelphia	96½	97
Philadelphia Traction	86¾	87
People's Traction	45¾	46
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. mtge. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	95	97
Columbus Crosstown 1st. 5s	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway, NEW YORK, Feb. 11, 1895.

THE BROOKLYN STRIKE is about spent. The cars are running with little or no interference from the strikers, although the service is somewhat hampered by the inexperience of the new men.

MR. EDGAR MIX, of the Thomson-Houston Electric Company, this city, was one of the passengers on the French steamer La Gascogne, which arrived to-day, more than a week overdue. His friends were becoming anxious.

AN AMATEUR PERFORMANCE of "East Lynne," undertaken by the New York Telegraph Operators' Association, Saturday night, Feb. 9, was brought to an untimely close by the excessive cold. A few of the party remained in the hall and danced out the night in ulsters and cloaks.

PITTSBURGH NOTES.

PITTSBURGH, Feb. 9, 1895.

THE PHŒNIX GLASS COMPANY'S factory near Rochester, Pa., was burned to the ground on the afternoon of Feb. 3. The loss amounts to $175,000 and 500 men were thrown out of work. The fire originated from a furnace. Immediate arrangements were made by the company to have its works operated somewhere else, and to-day it is stated that it has secured the lease of the Dithridge glass factory at New Brighton, and the plant will be in operation within a few days.

THE ALLEGHENY COUNTY LIGHT COMPANY has at last been able to locate a thief, who for a year or more caused the company a great deal of trouble. Complaints have been coming in to the company from a number of their patrons that a man, ostensibly representing himself as their employe, asked to examine their arc lamps. The request being granted, the man would decide that the lamps were out of order, and then he would take them away for repair. However, "he never came back," and in that way about a hundred lamps have been stolen. A few days ago the man even grew bold enough to go into a store opposite the light company's office and removed a lamp. Fortunately, he was known, traced, and eventually locked up. It was discovered the thief at one time occupied the position of inspector for the light company.

General News.

NEW INCORPORATIONS.

THE PHŒNIX TELEPHONE AND ELECTRIC COMPANY, Denver, Col., has been incorporated by P. H. Baker and others, with a capital stock of $750,000.

THE MARSEILLES (ILL.) TELEPHONE COMPANY has been incorporated by H.R. Adams, F.T. Neff, L. M. Jennings and R. F. Knott. Capital stock$ 2,000.

ELECTRIC LIGHT PHOTOGRAPHIC COMPANY, Chicago, has been incorporated by Oscar L. Sturtz, Robert E. Brown and Chris Florup. Capital stock $5,000.

THE HARRISON ELECTRIC COMPANY, Chicago, Ill., capital stock $500,000 has been incorporated by Edward M. Harrison, Lewis H. Painter and Lewis Rinaker.

THE LAS VEGAS WATER AND ELECTRIC AND POWER COMPANY, Santa Fe, N. M., has been incorporated by F. A. Manzanares, M. W. Browne, J. S. Duncan and John I. Pace.

VALDOSTA, GA.—The Valdosta Telephone and Telegraph Company has been organized by J. D. Whilaw, general manager, and others, to establish a line. All arrangements completed.

ATCHISON, KAN.—The Western Telephone Company, Atchison, Kan., incorporated by F. M. Baker, J. W. Sharrard, M. J. Traverse, R. A. Miller and E. D. Mills. Capital stock $10,000.

CLARKSVILLE, TENN.—The Clarksville Telephone Company has been organized by B. H. Owens, president; M. Savage, secretary; F. P. Gracey, D. N. Kennedy, B. H. Owens and others.

AMERICAN DISTRICT TELEGRAPH COMPANY has been incorporated by W. H. Wakefield, C. W. Coker, A. A. Clark, W. D. Hardin, Fred Davis, W. C. James and Emmet Tinley, of Omaha, Neb.

THE SAN ANTONIO ELECTRIC COMPANY has been incorporated at San Antonio, Tex., by R. T. McDonald, of New York and Fort Wayne; Edward J. O'Beirne and William H. McGaw. Capital stock $100,000.

THE LLANERCH HEAT AND LIGHT COMPANY, Llanerch, Pa., capital stock $25,000, has been incorporated to supply light, heat and power. The promoters are Ed. Worth, Mercer Strong and Frank A. Hays, Lansdowne, Pa.

THE UNITED SWITCH COMPANY, Newark, N. J., capital stock $100,000, has been formed to manufacture, purchase, sell and lease electrical machinery, etc. Henry C. Hines, Wm. C. Morton and Robert D. Beatty, Newark, are interested.

THE ANDERSON (S. C.) TELEPHONE COMPANY has been incorporated, with R. E. Ligon, president; L. P. Brock, secretary, and J. L. Maulding, superintendent. Plant will be constructed at once. Want telephones, wire, poles, insulator pins, brackets, switchboards, etc.

THE NEWTON LIGHT AND POWER COMPANY, Newton, Kan., capital stock $50,000, has been incorporated to furnish light, heat and power to Newton. The promoters are Lewis B. Gawtry, New York; Julius A. Bailey, Philadelphia, and John C. Nicholson, Newton, Kan.

SIGOURNEY ELECTRIC LIGHT AND POWER COMPANY has been incorporated by H. C. Brown, W. S. Harlan, H. O. Schipper, C. M. Harlan and E. Laffer, of Sigourney, Ia., with a capital stock of $8,000, to generate and furnish electricity for light and power in Sigourney.

THE FLORENCE BELT LINE RAILWAY COMPANY, Florence, Col., has been incorporated with a capital stock of $25,000, to build and operate an electric street railway in the town of Florence. Col. E. M. Weil, S. Siess, Leon Siess, C. L. Huff, all of Florence, Col., and James B. Crandell, of Denver, Col., are interested.

THE UNIVERSAL ENGINEERING COMPANY, of Baltimore, Md., has been incorporated to do a manufacturing, mechanical and industrial business, to make and sell electrical instruments, machinery and supplies; construct, own and operate telegraph and telephone lines. Capital stock $10,000. Promoters, Geo. W. F. Vernon, Theo. F. Wilcox, Wm. J. Klug, Julius Stern and Leopold Stern.

TELEGRAPH AND TELEPHONE.

JOHNSTOWN, PA.—The Johnstown Telephone Company has been organized.

WESTMINSTER, MD.—R. B. Hazlett is endeavoring to establish a telephone system.

ST. JOSEPH, MO.—A new telephone exchange is expected to be in operation by May 1.

MATTOON, ILL.—The Mattoon Telephone Company's plant is being rapidly pushed to completion.

MINNEAPOLIS, MINN.—The United Electric Company has applied for a telephone franchise.

IRONTON, MICH.—E. A. Croll has petitioned the City Council for a franchise for a telephone company.

TALLAHASSEE, FLA.—The Bell Telephone Company, of Atlanta, Ga., will construct a telephone exchange.

SEATTLE WASH.—The Sunset Telephone and Telegraph Company has been granted a franchise for 25 years.

SILVER CITY, N. M.—A telephone line wire is being strung between this city and the Mongollon country. It will be 80 miles long.

LOUISIANA, MO.—The work of putting in a new telephone system has been commenced. Already 100 subscribers have been obtained.

TAYLOR, TEX.—The Southwestern Telegraph and Telephone Company has been granted a franchise for a telephone system, and work is to begin on the plant within a few weeks.

CLARKSVILLE, KY.—Capt. E. P. Gracey, Hon. D. N. Kennedy, M. Savage, H. Owen, R. H. Burney and James Bowling, leading business men, have formed the Clarksville Telephone Company.

ROCK RAPIDS, IA.—A scheme is on foot here to organize a company for the purpose of putting in a telephone exchange to connect the towns in this county with Sioux City. The same company will also ask for a franchise from the city to put in an electric light plant.

SAULT STE. MARIE, MICH.—A party of capitalists have asked for franchise to operate a telephone line. The Edison Sault Electric Company is in the deal, and has proposed to string the wires on their electric light wire poles. The proposed company agrees to sell an instrument to subscribers for $35, and then furnish service at the rate of $15 a year for residences and $18 a year for business places.

ELECTRIC LIGHT AND POWER.

TAUNTON, MASS.—Municipal lighting is being urged.

RICHMOND, WIS.—An electric light plant is to be established.

NORTHFIELD, VT., intends putting in an electric light plant.

KINGSTON, N. Y.—The electric light project seems to have fallen through.

STAUNTON, ILL.—An electric lighting system will probably be established.

PEORIA, ILL.—The electric light company will soon increase its plant materially.

NEOSHOE, MO.—A $10,000 electric light company has been organized by John McElhany.

SMITHVILLE, GA.—Address Wells Bros. concerning the erection of an electric light plant.

LYONS, N. Y.—A dynamo may be added to the electric light company's plant here for lighting private residences; its present machines are loaded to their utmost capacity.

MARSHALL, ILL.—Address the mayor regarding the establishment of an electric light plant.

FULTON, KY.—Fulton town authorities are considering a petition for an electric light franchise.

NEWCOMERSTOWN, O.—The city has voted to issue bonds for the erection of an electric light plant.

MALCOLM, ILL.—The Grinnell electric light plant is advertised to be sold by the sheriff Feb. 18.

CAPE CHARLES, VA.—Address the city clerk concerning the establishment of an electric light plant.

DANSVILLE, N. Y.—The electric light plant here has been sold for $8,000 under mortgage foreclosure.

TECUMSEH, MICH.—The city will vote on the issue of $10,000 bonds to establish an electric light plant.

CLINTONVILLE, WIS., has granted D. S. Stewart a 20-year franchise for an electric light and power plant.

DOTHEN, ALA.—The mayor will give information regarding the establishment of an electric light plant.

MARTINSBURG, W. VA.—The city will issue bonds to the amount of $15,000 to purchase an electric light plant.

GREENSBORO, N. C.—Address the mayor concerning $25,000 to be issued to build or buy an electric light plant.

BALLARD, WASH.—City bonds have been sold to the amount of $42,000 for a water system and electric light plant.

WASHINGTON, ILL.—The machinery of the Washington electric light plant was recently destroyed by an explosion.

PINE GROVE, PA.—It is probable that a company of Philadelphia capitalists will erect an electric plant at Pine Grove.

MEXICO, N. Y.—The taxpayers have voted to light the streets of the city by electricity. They favor owning the plant.

UNION SPRINGS., ALA.—Address the Mayor concerning $30,000 of bonds to be issued for electric light plant and water works.

SABETHA, KAN.—Address City Clerk for information concerning $15,000 electric light plant and water works to be established.

WASHINGTON, D. C.—Address Bishop Keane concerning $50,000 electric light plant to be established at the Catholic University.

ST. JOSEPH, MO.—W. C. Stewart and associates have asked for a franchise for an electric light plant and it will probably be granted.

NIAGARA FALLS, N. Y.—It is reported that the Niagara Falls (Ont.) electric light company intends to spend $20,000 in increasing its plant.

BLAINE, ME.—Col. F. C. Robinson is thinking about an electric plant at his place to light up his village and mills, this place, and Mars Hill.

BOSTON, MASS.—The Edison Electric Light Company will erect a four-story building on Bumstead Court, to be used for a storage battery plant.

BALTIMORE, MD.—The Mount Washington Electric Light and Power Company has purchased a site on the Falls turnpike for a power house.

WINONA, MINN.—Mr. John F. Gay has been appointed manager of the Winona General Electric Company, vice Mr. Andrew H. Hill, resigned.

WASHINGTON, D. C.—The House Committee on Ventilation and Acoustics has recommended that an appropriation be made for an electrical plant.

NORWALK, O.—The local electric light plant, which has been in assignee's hands for the past two years, has been ordered sold at auction about March 1.

MT. STERLING, KY.—J. P. Martin, Xenia, O., may be addressed or information concerning the establishment of an electric light and railway system.

CANON CITY, ILL., has given the local electric light company a ten years contract from Feb. 1, for 19 or more full arc lamps at $11 per lamp per month.

ST. JOSEPH, MO.—The Wyeth Harness and Collar Factory was burned Jan. 11. The factory was equipped with dynamos and motors, which were totally destroyed.

DES MOINES, IA.—The Board of Public Works has awarded the contract for lighting the streets for the ensuing year at $8 per light per month. Arc lights will be used.

PINE GROVE, PA.—Steps are being taken to establish an electric light plant on the Octoraro, near Oxford. It is reported that 1,000 to 1,400 hp can be generated by the falls.

BALTIMORE, MD.—James L. Kernan will begin the erection on April 1 of a new theatre on the site of the Howard Auditorium. The house will be lighted by electricity.

RAWLINS, WYO.—The Rawlins Electric Light Company and the Dillon coal mines have consolidated, with M. W. Dillon manager. A telephone system is also contemplated by the company.

PALATKA, FLA.—The city has contracted with the Palatka Gas Light and Fuel Company for one hundred 32-cp incandescent lights and fifteen 2,000-cp arcs for five years. The lights must be in operation by April 9.

ELKHART, IND.—It is proposed to utilize the water power of the St. Joseph River by erecting a plant a few miles north of South Bend, to furnish power in Elkhart and neighboring cities for operating street railways and electric lights.

STAUNTON, VA.—The Augusta Electric Company has completed its new plant comprising four Edison 20-kw incandescent dynamos and two 80-hp Ideal engines. The city has abandoned commercial arc lighting and is placing fifty additional lamps on the streets.

KINGSTON, N. Y.—At a recent meeting of the Rondout harbor masters and pilots a petition to the Common Council was drawn up, asking that all the arc lamps along the river front be shaded so as to eliminate the confusing effect upon the pilots of the glare of the lights.

LORAIN, O.—A company with $100,000 capital has been organized to construct an electric line between Lorain, North Amherst and Wellington. E. M. Pierce, John Stang, Q. Gillmore, C. G. Washburn and James B. Hoge, of Lorain, are interested. Application will be made at once for a charter.

YORK, PA.—The rate war between the local Edison and Westinghouse companies is over, and prices have been very materially raised. The Edison company has served notice on its patrons that a discount of 10 per cent. will be substituted for the former discount of 50 per cent., beginning Feb. 1.

MONTREAL, CAN.—The St. Jean Baptiste Electric Company will shortly require additional equipment in the way of engines and dynamos, and the capital stock is to be increased to $500,000. The officials are Arthur Caron, president; Hon. Louis Tourville, first vice-president; Jos. Girard, second vice-president; Jules Bourbonniere, secretary and treasurer, and Otto Wendel, electrician.

GREELEY, COL.—A movement is on foot for the organization of a company to furnish light for the city and to operate a system of electric railways running through the country about Greeley, touching at Lucerne, Seeley's Lake, La Salle and other points. The company proposes to dam the Poudre several miles up and conduct the water in pipes to the works to be located on the bottoms below the city.

THE WAVERLEY (N. Y.) ELECTRIC LIGHT AND POWER COMPANY, which furnishes current for the town of Waverley, N. Y.; Sayre, Pa., and Athens, Pa., reports a very prosperous condition of affairs, and is a fair instance of the results obtainable by good management. This company a few years ago bought out the old Brush company, then insolvent, and installed new apparatus throughout, under the supervision of Mr. J. George Kaelber, of Rochester. The plant has now a capacity of 200 arc lights and 3,000 incandescents, and has paid dividends from the start. The active management of the company's affairs is in charge of its president, Mr. Kaelber, who is ably assisted by Mr. Fred. E. Lyford, vice-president and secretary, and Mr. Geo. C. Hoffman, superintendent, and much credit is due these gentlemen for the satisfactory results obtained.

THE ELECTRIC RAILWAY.

CICERO, ILL.—Cicero and Proviso Street Railway Company has increased its capital stock to $2,500,000.

OGONTZ, PA.—Ground has been broken for a new power house, work on which will be pushed vigorously.

MILTON, N. Y.—A franchise for an electric railway has been formally granted to the Ballston Electric Railroad Company.

TOLEDO, O.—The Toledo Consolidated Street Car Company will extend its line from Michigan avenue to the Robinson Casino.

PLAINFIELD, N. J.—The Plainfield Street Railway Company has petitioned the Common Council for permission to extend its lines.

NEWBURGH, N. Y.—An electric railway is contemplated from Newburgh to Patchin's Pond via the Middlehope and west neighborhood highway.

GENESEO, N. Y.—Citizens are considering the building of an electric railway from this place to Long Point, Conesus Lake, to be six miles long.

MANCHESTER, N. H.—Application has been made for charter for a crosstown and belt line electric road at Manchester, with a capital stock of $500,000.

NEW LONDON, CONN.—A company is being organized with a capital stock of $200,000, to build an electric railway between New London and Norwich.

STAUNTON, VA.—The City Street Railway Company is contemplating the substitution of electricity for horses, and a two-mile extension of its road.

PHILADELPHIA, PA.—The Tamaqua and Pottsville Trolley Company has borrowed $250,000 with which to build an electric line to connect the two towns.

PORTLAND, ME.—The Portland Railroad Company has applied to the Board of Aldermen to operate its lines within the city limits by the single trolley system.

DENVER, COL.—By the explosion of a battery of boilers at the West Side station of the Tramway Electric Railway the power house was reduced to ruins. Loss $50,000.

NORWALK, CONN.—South Norwalk City Council has appointed a committee to oppose a petition of the Norwalk Street Railway Company for permission to extend its lines.

BRATTLEBORO, VT.—The proposed electric street railway in Brattleboro is meeting with opposition on the part of some of the citizens, among them Ex-Governor Fuller.

CONCORD, N. H.—Hon. Thos. Sanders, of Haverhill, Mass., has been in this city furthering his scheme of an electric railway from Haverhill, Mass., via the Merrimack Valley to Quebec.

SOUTH WEYMOUTH, MASS.—Chas. H. Blood, C. H. French and W. O. Chapman, of the Weymouth and Braintree Street Railway Company, have asked for a franchise for an electric road.

KEARNEY (P.O. ARLINGTON), N. J.—The Union Traction Company of Rutherford has petitioned for permission to run a trolley line along the Belleville Townpike road and on Elm street, Kearney.

BALTIMORE, MD.—The City and Suburban Company has decided to build its Cantonsville double-track extension of the Point Breeze road to St. Helena as soon as possible. J. E. Hayward is superintendent.

WHITE PLAINS, N. Y.—The Board of Trustees has granted a franchise to the New York, Elmsford and White Plains Railroad Company to construct and operate an electric railway, to be completed by Aug. 1.

BOONSBORO, MD.—The Boonsboro and Keedysville Electric Railway will probably be reorganized by Dr. A. W. Lakin, S. S. Davis, Samuel Knode, A. C. Huffer, J. C. Brining, D. W. Barkman and H. S. Beard.

PITTSBURGH, PA.—The Carnegie branch of the West End Traction Company is rapidly nearing completion, and as soon as the weather moderates the tracks will be completed to Carnegie borough within three weeks.

JOPLIN, MO.—The Joplin Electric Railway and Motor Company has changed hands, and the franchise, real estate and rolling stock is now the property of the Carthage, Webb City, Joplin and Galena Railway Company.

CORNING, N. Y.—The Corning and Painted Post Electric Railway will be begun not later than March 1, and completed by Dec. 1 of this year, and will cost from $125,000 to $150,000. The franchise extends fifty years.

MARINETTE, WIS.—The street railway company of this city will extend its tracks along the bay shore to a new park purchased last fall. The extension will be two miles in length, and will occasion an outlay of $20,000.

BALTIMORE, MD.—Thos. B. Hatch and James Gilmore are directors of the Baltimore, Middle River and Sparrow's Point Railway Company, which desires to secure a franchise for its extension along several suburban streets.

REMSEN, N. Y.—An effort is being made to organize a company to build an electric railroad to connect Remsen with Hinckley, a distance of five miles. The Trenton Falls Lumber Company may be addressed for information.

ELLSWORTH, ME.—An electric railway from Ellsworth Falls to the bar in Union River is contemplated. A gentleman has made a proposition to furnish

two-thirds of the capital required, provided the other third can be raised by the city.

JEFFERSON CITY, MO.—A company is being organized to build and operate an electric railway across the new bridge, the purpose being to connect Jefferson City for freight and passenger business with the two railroads across the river.

CORNING, N. Y.—The Common Council decided to modify the C. & P. P. Company's franchise in such a manner that the company accepted the franchise and will build the road. Work on the road must begin by March 1 and be finished by Dec. 1, 1895.

PEORIA, ILL.—The Fort Clark electric road is in the hands of a receiver, suit having been brought by the Illinois Trust and Savings Bank, which holds a mortgage on it for $250,000, having advanced the money to equip it. This line is several miles in length.

HIGHLAND PARK, ILL.—The Interurban Railway Company is securing the right of way for an electric railway from the Cook County line north to Fort Sheridan. The right has been secured through Highwood village and will be asked through this city and the county.

STROUDSBURG, PA.—It is rumored that a charter will be asked for an electric railway to connect at Stroudsburg with the Bangor, Pen Argyl and Wind Gap Electric Railway Company's line, and run over to Saylor's Lake. Henry Fulmer, of Easton, is one of the principal projectors.

AUGUSTA, ME.—A bill has been introduced to incorporate the Somerset Traction Company. Those interested are R. B. Shepherd, Thos. H. Anderson, Jos. P. Oak and others. It is proposed by the promoters to operate an electric railway between Skowhegan, Madison, Cornville and Athens.

BANGOR, ME.—A. F. Gerald, of Fairfield, president and general manager of the Bangor, Orono and Old Town Railway, says the electric road will be built at the earliest possible time between Bangor and Old Town. Hon. I. C. Libby and C. E. Richardson, of the Worcester Construction Company, are interested.

YORK, PA.—Capt. William H. Lanius, president of the electric railway companies of York City, proposes to build railways from York to Dallastown, York to Dover, York to Manchester and York to Wrightsville, and says work will be commenced as soon as the legislature allows electric railways to carry freight. There is a bill pending now to this effect.

CLEVELAND, O.—Mr. L. M. Coe, of this city, has been authorized to operate an extension of his electric street railway in Rockport Hamlet. Mr. Coe already has the right to construct and operate an electric street railway across the new Stranahan bridge now in process of construction across Rocky River, and thence westerly through the counties of Cuyahoga and Lorain to the city of Elyria.

NEW HAVEN, CONN.—A petition has been in circulation for the last few days to urge upon the New Haven Street Railway Company the advisability of laying double track on Whitney avenue from the city to the lake. The petition has been very generally signed, and efforts will be made to induce the street railway company to take the necessary steps to secure the improvement.

NORTHAMPTON, MASS.—A petition to the legislature has been presented by Lyman D. James, of Williamsburg; Alvan Barrus, of Goshen; J. C. Hammond, of Northampton; John Olmstead, of Springfield, and others, for the incorporation of the Western Hampshire Street Railway Company, with a capital of $200,000. The proposed road is to run from Williamsburg to Goshen, Cummington to Worthington, the total distance being about twenty miles

READING, PA.—The stockholders of the Mount Penn Gravity Railroad Company, at its annual meeting in Reading a few days ago, agreed to take the second mortgage bonds of the company at 75 per cent. of their face value, the payment of the coupons to be deferred for four years. The money raised will be used in discharging all the indebtedness of the company except the first mortgage of $40,000. The road will be operated this year as usual, the season opening about April 1.

ATTLEBORO, MASS—The Boston Safe Deposit Company, under a deed of trust, has conveyed to Edward R. Price, cashier of the Mutual Bank of North Attleboro, as trustee, all the property of the Attleboro, North Attleboro and Wrentham Street Railroad Company, the consideration being $50,000. Coupled with this is the sale by W. H. Haskell, of Pawtucket, of the North Attleboro Steam and Electric Company to the Attleboro Steam and Electric Company, for 647 shares in the stock of the latter company, subject to a mortgage of $10,000. This means an immediate starting up of an electric road in this town.

ELYRIA, O.—The construction of the electric street railroad from Cleveland to Elyria will be begun as soon as the frost leaves the ground. The distance between the public square of Cleveland and Elyria is 25 miles. The road will connect with the Lorain street line. The tracks of the Berea street railroad will be used for four miles. The new company will have but 16 miles of track to build, and the western terminus will be the public square at Elyria. The officers of the company are: President, A. H. Pomeroy, Berea; vice-president, L. M. Coe; secretary, A. E. Atkins; treasurer, F. T. Pomeroy, of Cleveland.

NEW BRIGHTON, S. I., N. Y.—The Staten Island Interior Railway, Staten Island Midland and the Staten Island Electric Railway companies applied for rights to build electric railways through the streets of the village, each of the companies asking for a separate route, with the exception of the ferry approaches, for which all asked. The trustees granted all the rights to run to the ferry landing on condition that each permit the others and any others who might come in the future to run over the tracks. The understanding is the companies will unite in building that portion of the road which they will use in common.

MISCELLANEOUS NOTES.

SUNDAY LECTURES ON ELECTRICITY.—The first of a series of Sunday afternoon lectures on electricity was on Feb. 3, at Cooper Union, New York, under the auspices of the National Association of Stationary Engineers. These lectures will be continued until April 28.

Trade and Industrial Notes.

CALENDARS.—The Central Electric Company, of Chicago, Buckeye Electric Company, of Cleveland, and Alfred F. Moore, of Philadelphia, are distributing among the trade some handsome and useful calendars for 1895.

THE INDIANA TELEPHONE AND CONSTRUCTION COMPANY, Frankfort, Ind., has secured a contract from the Merchants' Mutual Telephone Company, of Michigan City, Ind., to equip its plant with the Strowger Automatic Telephone system.

THE GERSON ELECTRICAL MANUFACTURING COMPANY, of Philadelphia, is a new competitor in the telephone field. Some very strong claims are made for its instruments, which are said to work equally well on very long and very short lines.

MR. JOSEPH SACHS will represent at the Cleveland Electric Light Convention the following firms: D. Van Nostrand Company, Scientific Book Publishers; The Solar Arc Lamp Company; the McCreary Electrical Specialty Company, and Rossiter & MacGovern, all of New York.

THE D. & D. ELECTRIC COMPANY, of Minneapolis, Minn., is to be congratulated upon a most attractive show-card calling attention to its well-known dynamos and motors. This card is one of the handsomest specimens of tasteful advertising lithography we have seen.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has issued an 1895 catalogue of street railway supplies which is most comprehensive in its scope and complete as to details. The print is unusually good, and the book is provided with a substantial and handsome embossed cover.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., has issued a handsome pamphlet of 24 pages (Catalogue "B"), describing numerous forms of the Hart snap switch. Among these, besides the usual forms, are 3 and 4-way switches and many varieties of flush-plate switches.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has just completed the new power house for the Hartford Street Railway Company, and it is said to be one of the finest, if not the finest, in the New England States. It is 66 ft. wide and 230 ft. long, entirely fireproof, no woodwork at all being used about the building.

THE WILMOT & HOBBS MANUFACTURING COMPANY suffered a serious loss on Monday, the 4th inst., when its rolling mill and factories at Bridgeport, Conn., were entirely destroyed by fire. The company will at once commence rebuilding its plant, and hopes that in the course of three months it will be able to have manufactured goods ready for the market.

MR. JOHN A. JUST, of Rochester, N. Y., has perfected a new paving compound which he calls "Asphaltine." It is claimed that asphaltine is a good insulator, non-absorptive and not subject to decay, and it has been suggested that in view of these properties the compound might be also used to advantage in protecting underground pipes from the electrolytic influence of street railway currents.

THE FISCHER FOUNDRY AND MACHINE COMPANY, Pittsburgh (S. S.), Pa., has issued a large page and well illustrated catalogue descriptive of the Fischer high-speed automatic engine, the construction of which is shown in a number of well-executed sectional views. The makers claim for their engine that its regulation is unsurpassed, and the counter-balancing is so even that the engine will run at its rated speed on a smooth plate without holding down bolts. Particular attention has been paid to material, workmanship and finish.

THE INTERIOR WIRING AND FIXTURE COMPANY, of No. 60 West Twenty-sixth-street, New York, is placing on the market a line of aluminium reflectors for incandescent lamps, for which special advantages are claimed. One form of reflector is made to be held between the neck and tip of any incandescent lamp, without the use of a shade holder, and is claimed to be entirely self adjusting. Another type is made in the form of a narrow ring to slip down over the lamp about half-way the bulb. It is claimed that these reflectors will never tarnish.

THE ELWELL-PARKER ELECTRIC COMPANY OF AMERICA, Cleveland, O., is now building for the Cleveland City Railway Company a 1 000-hp direct-connected railway generator that is to be driven by a triple-expansion condensing engine of the marine type, manufactured and supplied by the Globe Iron Works, of Cleveland. The speed of the generator and engines is to be 110 revolutions per minute. This combined plant is designed to work at an efficiency as high, if not higher, than anything heretofore obtained. The maximum overload capacity of this plant is to be 2 000 hp.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY, New York city, has just been awarded the contract for 15 electric elevators in the Parrott Building, San Francisco, in competition with hydraulic machines. Eleven of these are Sprague-Pratt multiplying-sheave machines, and four are the new Sprague tandem-drum machines. This is one of the largest buildings and one of the largest elevator plants in the world, and coming immediately after the awarding of the machines for the Boston Globe Building and the New York Custom House, emphasizes the "passing" of the hydraulic elevator.

MR. J. R. WILEY has just been engaged by the Standard Underground Cable Company to represent them in the West, with headquarters in the Rookery Building, Chicago. Mr. Wiley is well-known in electrical circles, having been connected with electrical enterprises for many years. He is a brother of Mr. Geo. L. Wiley, who has represented the Standard Underground Cable Company in New York and the East for the past ten years. Mr. J. R. Wiley assumed the management of the Western sales department, made vacant by the untimely death of the well-known and popular Fred. E. Degenhardt.

THE NEW YORK ELECTRIC EQUIPMENT COMPANY, S. Bergmann president, contractors for electric light plants, construction and wiring, as well as agents of the Edison Illuminating Company, of New York, for the Edison patented supplies, has removed its principal offices and salesroom to the new and commodious building occupied by its works at Nos. 572 to 578 First avenue, corner of Thirty-third street. The more central location of the company's new headquarters, and the increased facilities consequent upon bringing together its

executive, selling, constructing and manufacturing forces in one building, will enable it to meet the demands of its rapidly increasing business more promptly and thoroughly than ever. The building at 59 Duane street, where its offices were formerly located, will continue to be occupied by the company as a branch salesroom for the convenience of nearby customers, and as a branch supply depot for other contractors. The company is now approaching the close of its third year of business as successors to the construction, wiring and supply department of the Edison Electric Illuminating Company, and the removal was rendered necessary by the fact that it has outgrown the facilities offered by its old quarters at the corner of Duane and Elm streets.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

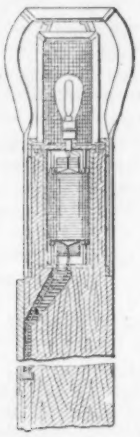
BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 5, 1985.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

Re-issue 11,470. APPARATUS FOR STOPPING ENGINES; F. D. Taylor, Hartford, Conn. App. filed Jan. 3, 1895. This comprises a spring actuated shaft, clutch parts connected therewith, releasing and resetting mechanisms comprising with other elements a tumbler, and a swinging shipping lever in operative engagement with each other.



No. 533,459.—Electrically Lighted Buoy.

533,427. AUTOMATIC TELEPHONE SWITCH; H. D. Bayne, Brooklyn, N. Y. App. filed May 31, 1894. This comprises a bracket for holding the receiver, having one jaw stationary and the other pivoted, the latter being adapted to engage a sliding bar.

533,445. ELECTRIC DENTAL MOTOR APPARATUS; F. N. Denison, Toronto, Canada. App. filed May 26, 1894. The combination of a foot pedal pivoted, swiveled and making contact, of an insulating plug provided with an insulating ring.

533,447. ELECTRIC RAILWAY; J. G. Douty, Williamsport, Pa. App. filed May 17, 1894. This comprises a car and trolley wire, a frame secured to the car, a tubular arm having trunnions mounted on the frame, springs between the tubular arms and the bearings of its trunnions, a trolley arm carried by the arm, and a trolley wheel carried by the trolley arm.

533,459. ELECTRICALLY LIGHTED BUOY; I. W. Henry, New York. App. filed May 29, 1893. The combination of a buoy, a transformer housed in a socket formed in the buoy, and a lamp or lamps electrically connected with the low tension winding of the transformer. (See illustration.)

533,490. ELECTRIC FIRE ALARM AND POLICE SIGNAL BOX; G. E. Paynter and W. H. Thompson, Richmond, Va. App. filed May 4, 1894. This comprises a releasing lever, signal transmitting mechanism, locking device normally engaging the releasing lever, and means operated by the sliding movement of a key upon its insertion in the door for unlocking the lever.

533,502. METHOD OF AND MEANS FOR TESTING INCANDESCENT LAMPS; F. S. Smith, Pittsburgh, Pa., and J. A. Vandegrift, Allegheny, Pa. App. filed July 9, 1894. The method of definitely ascertaining the proper moment for putting lamps, under process of exhaustion, into circuit for the purpose of expelling occluded gases, which consists in causing electrical oscillations of high frequency and potential to pass from the circuit aforesaid through the space within the lamp bulb.

533,607. INSULATED CONDUCTOR; H. G. O'Neill, Boston, Mass. App. filed March 22, 1894. This consists of a paste composed of powdered silicates and rendered waterproof.

533,619. TELEPHONE ARM REST AND RECEIVER HOLDER; W. Stuebing, Cincinnati, O. App. filed Oct. 30, 1894. This comprises a rod moving in a bar and bent near its upper end, a spring holding the rod in place, a curved and forked support for the receiver attached to the upper end of the rod, a round and notched bar held vertical by arms on the base, an elbow rest at the top of the arm, a sleeve adjustable on the vertical bar with which the arm is integral, and a pawl pivoted in the socket and holding it in place on the bar.

533,627. CONDUIT ELECTRIC RAILWAY; W. H. Baker, Pawtucket, R. I. App. filed May 18, 1894. A trolley having an elongated dome-like hood for catching drip falling through the conduit-slot, the hood terminating at each end in a down-turned point and having troughs along each side leading to the points. (See illustration.)

533,631. SUBWAY FOR ELECTRIC RAILWAYS; F. E. Button, Rochester, N. Y. App. filed June 5, 1894. The combination with the opposite rails, a cross-sleeper arranged beneath the rails, and a tie bar having a downwardly deflected central portion secured to the cross-sleeper, and upwardly extending extremities secured to the rails.

533,698. SAFETY CONNECTION FOR ELECTRIC CONDUCTORS; R. E. Bates, Brooklyn, N. Y. App. filed June 20, 1894. This comprises supports, a cover plate connecting a conductor with the cover and having vertical slots at their outer ends and horizontal slots at their inner ends, and bolts for engaging the slots.

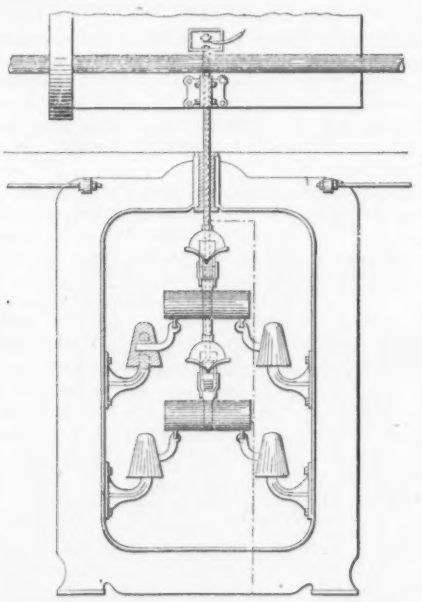
533,729. TELEPHONIC OR ANALOGOUS ELECTRODE; T. McCoubray, New York, N. Y. App. filed Aug. 9, 1894. A telephonic electrode made from carbon residuum of an oil such as petroleum, which residuum is recarbonized.

533,751. SEPARATOR PLATE FOR STORAGE BATTERIES; P. G. Salom, Philadelphia, Pa. App. filed May 9, 1894. A separator made of non-conducting material having perforated flat sections, one side adapted to rest against a battery plate, and having hollow ribs formed by crimping the plate, the ribs being on one side only so as to leave a space between the main body of the separator and the battery plate resting against the ribs.

533,785. TELEPHONE EXCHANGE; M. Brooks, Minneapolis, Minn. App. filed Oct. 17, 1894. The induction terminals comprising each a hollow coil and an iron core coil together mounted upon an iron yoke, the two terminals being adapted to be placed together to form a closed circuit magnetic induction coil.

533,791. ELECTRIC BATHING APPARATUS; C. Doehring, New York, N. Y. App. filed June 22, 1894. This comprises a tub having a heating jacket, and a pad of flexible metal sheets suspended therein and constituting electrodes.

533,795. ELECTRIC BROILER OR TOASTER; L. T. Edwards, Haverford, Pa. App. filed March 2, 1894. This consists of a frame, a grid contained therein and through which the current is intended to pass, and insulating connections between the opposite side portions of the grid and the frame.



No. 533,627.—Conduit Electric Railway.

533,810. CONDUIT ELECTRIC RAILWAY; A. Rosenholz, San Francisco, Cal. App. filed May 22, 1894. This comprises means for intermittently transmitting current from main line conductors to the cars as they pass along the track, the connection with each switch being cut off as soon as the car has passed.

533,836. CONDUIT SYSTEM; C. M. Yost, Washington, D. C. App. filed Nov. 3, 1894. This comprises a main conductor, alternately arranged, fixedly mounted conductor bars, having an independent connection with the main conductor and arranged with their ends overlapping and a separate plate for each bar by which it is secured in proper position with relation to the slot.